A STUDY OF STUDENTS COMMON ERRORS WITH SPECIAL REFERENCE TO THE EFFICACY OF THE OBJECTIVE BASED EXAMINATION SYSTEM IN ELEMENTRY MATHEMATICS, SECONDARY EXAMINATION, 1972

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CHAPTER - FIRST

INTRODUCTION OF THE PROBLEM

The Board of Secondary Education, Rajasthan has made concerted efforts to improve secondary education by undertaking the following reforms.

1. It has improved and modernised the syllabii of secondary and higher secondary classes with a view to raising the standards at par with the standards obtained in the other progressive countries.

2. It has made a drastic change in the examination system by introducing the modern techniques of examination.

3. It has specified the objectives of teaching the school subjects in specific terms.

4. It has oriented teachers in the objective based techniques of examination by organising various workshops.

5. It has changed the pattern of setting question papers. Formerly there used to be only ten or eleven essay type questions in the question paper and on account of limitations of the time factor only 5 or 6 were to be solved or answered from the whole paper. It is quite obvious that according to the old pattern if a candidate memorised a set of important questions, covering only 60 per cent of the syllabus, he could secure 90 percent to 100 percent marks. Actually it was only a memory test, his understanding was not at all tested. The new pattern of question papers commands the following peculiarities:-

(i) It covers all areas of testing, viz. knowledge, understanding, application and skill etc.

(ii) It incorporates different forms of questions like objective type (multiple choice), very short answer type, short answer type and a few essay type questions. Since multiple choice type, very short answer type and short answer type questions need much shorter time to be answered, an examiner can set quite a large number of such questions covering the entire syllabus in its testing design in the specified time of three hours or two and a half hours.

(iii) It offers little choice in regard to the number of questions to be answered and as such, with a view to covering the entire syllabus, testing all the objectives of teaching and employing all the forms of questions. The question paper is later on moderated so that the deficiencies occuring in the question paper, if any, may be eliminated.

6. It has reformed the method of setting a question paper also. According to the present method a paper setter, before setting a question paper, has to form a blue print and design of the paper.

7. It has trained paper setters in the improved techniques of setting question papers by holding a number of paper setters workshops in different subjects. After experimenting this new pattern for a number of years the Board has considered it desirable to examine how far this pattern has proved effective in attaining the desired goals. With a view to assessing the effectiveness of the objective

based patterns of questions papers and analysing the errors committes by candidates in terms of objectives and units of the syllabus in different subjects, the Board has taken up a Comprehensive Research Project. The project covers a number of subjects like English, Elementary Mathematics, General Sceince, Optional Mathematics, Physics and Chemistry at the secondary stage. The study is mainly based on the answer scripts of candidates appearing at the Board's examinations. The study is being conducted by setting up one working group for each of the above mentioned subjects. Shri P.L. Pareek, Academic Officer, Board of Secondary Education is the overall Director of the Project. Besides, coordinating the activities of the different working groups, he has associated himself with the execution of the study by each study group at all stages of its operation. It is hoped that the findings of the study will help in developing a remedial programme of action for effecting appropriate improvements in the teaching of different subjects so that the objectives of the teaching designed for the subject may be realised in classrooms situations. Besides, the improvement in teaching it is contemplated that the findings of the project will also help in improving the pattern of question paper.

1.2 Objectives of the study

The present study is, therefore, an integral part of the overall project as outlined above. The analysis of the question paper of Elementary Mathematics and the assessment of the answer scripts of candidates in the subject with a

view to diagnosing the achievements of candidates in term of different objectives and different units of study will help and realise the following objectives:-

(i) It will help us locate the errors committed by students due to the faulty understanding of the concepts, processes, principles, formulas, etc.

(ii) The study will also help us locate the actual causes of these errors which will help us in improving the teaching and learning techniques.

(iii) This study will help establish inter-relationship between various units of the subject and the common errors could be viewed in the perspective of these inter-relationships which might help teachers in devising ways and means to attack these errors.

(iv) The study will help us discover as to what extent the objectives of knowledge, understanding, application and skill as outlined for the subject are actually realised by the candidates.

(v) The study will also help assess the adequacy or inadequacy of the different forms of questions in testing different objectives in the subject.

(vi) Finally this study will actually be useful to teachers in improving their classroom teaching and to the paper setters in redesigning the pattern of question paper in Elementary Mathematics so that the weightage on objectives of teaching and the forms of questions may be rendered compatible.

PROCEDURE AND METHOD OF CONDUCTING THE STUDY

2.1 With a view to studying the objectives as outlined in Chapter first, the Board set up a three member working group to work on this project. The group consisted of:

1. Dr. P.C. Kunot, Deptt. of Maths, University of Jodhpur, Jodhpur - Convenor
2. Shri H.N. Gupta, Deptt. of Maths, Regional College of Education, Ajmer - Member
3. Shri U.A. Goel, Principal, Railway Multipurpose Higher Secondary School, Abu Road - Member.

Shri H.N. Gupta could not, however, work on the project for long as he had to go abroad.

2.2 Since the universe under research work was for the paper of Elementary Mathematics for the secondary examination, 1972, the sampling of answerscripts was done from the whole lot of the answerscripts of the year 1972. The sampling of scripts was done by a combination of startified and the random sampling techniques. The startified sample took note of the following variables:

1. Passes and failures,
2. Grade variations among the passes.

The selection of the answerscripts was primarily based on the variable of grades obtained by the candidates. The number of answerscripts under each category of grade was determined exactly on the basis of the percentages of 1st, 2nd, 3rd and failures declared in the Board's results in the subject. The exact number of answerscripts selected in Elementary Mathematics was 300 (three hundred).

2.3 PREPARATION FOR THE TESTING:

Before finalizing the exact work to be carried out, the Convenor and the other co-evaluators (members) met thrice at the Board office, Ajmer.

In the first meeting, the group discussed the outline of the work to be carried for this project and decided first of all to go through the main goals and objectives of teaching Elementary Mathematics. The following goals of teaching Elementary Mathematics paper to all the candidates as a compulsory subject, (except those who offer optional Mathematics) as approved by the working group are listed below.

1. To educate students in the subject of Elementary Mathematics which is useful to solve the problems of day to day life, trade, home and other spheres of life.

2. Knowledge of Mathematics is basic to the understanding of various other subjects like statistics, Economics, Geography etc. One of the main objectives of teaching this subject is, therefore to impart the basic concepts to enable them to understand other subjects.

3. To create interest in the students for Mathematics in order to realise the goals stated above, we have devised operational objectives which are given below:-

1. Knowledge - comprehension.
2. Understanding.
3. Application.
4. Skill.
5. Attitude.
6. Interest.
7. Appreciation, etc.

The objective based teaching is supposed to cater the above operational objectives. It is desirable, therefore, assess the testing programme on the criterion whether these jectives have been attained or not by the candidates. The estion paper should naturally, therefore, be objective sed. Usually the testing objectives in mathematics are ly four and these are knowledge, understanding, application d skill.

The following is a categorisation of questions on e basis of these objectives.

1. Knowledge: Questions which need recall or recognition mathematical terms etc. comeunder this category.

2. Understanding: Questions testing the following ility or abilities come under this category:

i) capacity of giving illustration,
ii) capacity of detecting errors and correcting them,
iii) capacity of identifying relationship in the given dat
iv) capacity of translating verbal statements into symbolic relationship and vice-versa,
v) capacity of explaining mathematical terms,
vi) capacity of comparing related mathematical concepts, principles, etc.,
vii) power of discriminating between closely related concepts, terms, symbols, etc.,
viii) capacity of classifying the data as per criteria,
ix) capacity of verifying results, and
x) capacity of estimating results.

3. Applications: Questions involving the following ilities come under this category:

i) reduce an unfamiliar situation to a familiar one,
ii) judge the adequacy, relevancy, consistency or superfluity of data,
iii) establish relationship in the given data,

iv) suggest alternative methods of solving the question,
v) select the most appropriate method or process to solve the problem,
vi) make generalizations,
vii) point out exceptions,
viii) draw inferences, and
ix) frame novel situations.

4. Skill: In case the pupil has to either handle the mathematical instruments or draw geometrical figures and graphs or read tables, charts and graphs etc. or do the computation work, it is considered to test the skill of the pupil in the subject of Mathematics.

The following distribution of marks among these objectives is considered to be fair by the experts on pedagogy:

Knowledge	35%		40%	
Understanding	40%	or	40%	
Application	15%		10-15%	20%
Skill	10%		10-5%	

The question paper of Elementary Mathematics for the examination of 1972 was reviewed to find out the objectives of the questions set in it and we found that

(i) Questions testing knowledge were -

Part A - 1, 2, 3, 4, 5, 6, 7, 9, 11, 13, 18, 22.

Part B - 2, alternative of 3, 9, alternative of 9, 12

Total marks - $6\frac{1}{2} + 11 = 17\frac{1}{2}$.

(ii) Questions testing understanding were -

Part A - 8, 10, 12, 14, 15, 16, 17, 24, 19

Part B - 1(a), (b), (c), (d), 3, 6, alternative of 7, 8, 10, alternative of 10

Total marks - $5\frac{1}{2} + 24 = 29\frac{1}{2}$

(iii) Questions testing application were -

Part A - 20, 21, 23

Part B - 4, 5, 7, 11, 13

Total marks - 3 + 11 = 14.

(iv) Questions testing skill were -

Part A - Nil

Part B - 14

Marks - 4.

From the data the following were observed.

(i) In questions where internal option was given, the paper setter failed to keep the same objective for the questions. In general whenever an internal option is given, both the sets of questions should always test the same objective.

(ii) When two questions from different objectives are set in the internal option, the distribution of marks among the different objectives is distributed. distributed

(iii) Question No. 24 of part A of the paper does not have a definite answer. Such questions should not be set in a question paper.

The working group prepared a scheme of model answer for each question and classified its main steps in terms of processes involved in the answer. It then listed the possible expected errors for each question. The working group then took up the scrutiny of answerscripts with a view to preparing an exhaustive list of errors under each process or step of the question.

In the second meeting we finalised our evaluation tools and the list of processes and possible errors in terms of each question.

In the third meeting we finalized the proformas with a view to collecting the data in regard to processes and errors.

2. COMPILATION OF STATISTICAL DATA:

The Convenor and each of his two evaluators were provided with a sample of 100 scripts from the Board which were to be assessed. After assessment each coevaluator sent a sample of 10 scripts with their assessment to the convenor who looked into their assessment to judge whether the assessment done was in accordance with the decisions taken and was properly done. When the work was going on Shri H.N. Gupta left for abroad and consequently his sample of 100 scripts was reassessed by the Convenor Dr. P.C. Kunot as per the decision of the Board.

After completing the assessment each evaluator consolidated his data and sent the same to the Convenor who made final consolidations of the data.

The Convenor prepared the draft report on the basis of these collected statistics. The report was later processed and edited by the Project Director Shri P.L. Pareek.

CHAPTER - THIRD

ANALYSIS AND INTERPRETATION OF DATA OF SECTION - A (CONSISTING OF MULTIPLE CHOICE AND SHORT ANSWER TYPE QUESTIONS)

Before we proceed to analyse the questions and look for the interpretation of the collected data, it is worthwhile to have a glance at the syllabus.

The syllabus for the examination of 1973 consisted of the following chapters.

1. ARITHMETIC
   - i) Square root;
   - ii) Cube root by factorisation;
   - iii) Average
   - iv) Percentage;
   - v) Simple Interest;
   - vi) Compound interest;
   - vii) Profit and loss;
   - viii) Time and distance;
   - ix) Work, time and wages;
   - x) Ratio and proportion;
   - xi) Division into proportional parts; and
   - xii) Partnership.

2. ALGEBRA
   - i) Factors based on the following:
     - (a) $ak + bk + ck = (a + b + c)k = k(a + b + c)$;
     - (b) $a^2 + 2ab + b^2 = (a + b)^2$;
     - (c) $a^2 - 2ab + b^2 = (a - b)^2$;
     - (d) $a^2 - b^2 = (a + b)(a - b)$;

ii) Factors of simple quadratic trinomials with numerical coefficients;

iii) Simple equations;

iv) Simple linear simultaneous equations and easy problems related to them;

v) Quadratic equations in one unknown and easy problems related to them; and

vi) Reading and drawing of graphs related to statistical data - such as
(a) Rectangular;
(b) Circular;
(c) Pillar diagrams

and drawing and reading of graphs (on graph paper) related to statistical data.

vii) Logarithms - Definition, base of a logarithm, properties of logrithms

(a) $\log_a MN = \log_a M + \log_a N$;

(b) $\log_a \frac{M}{N} = \log_a M - \log_a N$;

(c) $\log_a M^N = N \log_a M$;

(d) $\log_a a = 1$;

(e) $\log_a 1 = 0$;

(f) $\log_b a \cdot \log_a b = 1$;

(g) $\log_b a = \log_c a / \log_c b$.

Common logarithms, characteristic and Mantissa of arithm to the base 10; use of logarithmic tables; use garithms in finding the values of expressions involving and fractional powers of a quantity.

3. SET THEORY:

Definition of a set, elements of a set, set notations, representations of a set, empty set (void, vacuous, null set), universal set, subset, complement of a set, union and intersection of sets; Venn diagrams.

4. GEOMETRY:

Use of the following geometrical theorems:

i) the area of a rectangle is the product of its length and breadth;

ii) the rectangles and parallelograms drawn on the same base and between the same parallels are always equal in area;

iii) if a triangle and a rectangle or a parallelogram are drawn on the same base and between the same parallels, then the area of that triangle is equal to half of the area of the rectangle or parallelogram;

iv) parallelograms drawn on the same base and between the same parallels are always equal in area;

v) triangles drawn on the same base and between the same parallels are always equal in area;

vi) the square of the hypotenuse of a right angled triangle is the sum of the square of the other two sides of the triangle;

vii) the circumference and area of a circle of radius r are $2\pi r$ and πr^2 respectively;

viii) the area of the curved surface and the volume of a right circular cylinder, where height is h and base radius is r are $2\pi rh$ and $\pi r^2 h$ respectively;

ix) volume of a rectangular solid is the product of its length, breadth and height; and

x) simple problems of daily life based on the above mentioned topics. The problems of flooring,

carpeting, area of paths inside and outside a rectangular and circular fields, area of the four walls, volume of a rectangular cuboids, solids, hollow rectangular cubes, and the problems related to the volume and surface area of the cylinder and expenditures etc.

5. TRIGONOMETRY:

Trigonometrical ratios and relations among them, simple identities values of the trigonometrical ratios of 0°, 30°, 45°, 60°, and 90°. Solution of right angled triangles, Logarithmic tables may be used in solving the problems on solution of right angled triangles.

Q.No. 1 Topic - On Square root.

Objective - Knowledge

Expected Errors -

(A) Square root of a rational number $\frac{a}{b} = \sqrt{\frac{a}{b}}$ e.g. in this problem square root of $1\frac{9}{16} = \frac{25}{16}$.

(B) Square root of $1\frac{9}{16}$ = square root of 1 x square root of $\frac{9}{16}$

$= 1 \cdot \frac{3}{4} = \frac{3}{4}$

or

Ignores the integral part while finding the square root and gets $\frac{3}{4}$.

(C) Square root of $1\frac{9}{16}$ = square root of 1 + square root of $\frac{9}{16}$

$= 1 + \frac{3}{4} = 1\frac{3}{4}$.

	A	B	C	D	Omitted	Total
First class	1	1	47	2	x	51
Second class	5	x	52	10	x	76
Third class	5	11	65	19	2	102
Failures	9	6	33	18	5	71
Total	20	18	197	58	7	300

Percentage $6\frac{2}{3}$ % 8 % $65\frac{2}{3}$ % $19\frac{1}{3}$ % $2\frac{1}{3}$ % 100 %

From the statistics we observe that -

(i) Only 2% first class, 7% second class, 5% third class and about 13% failures committed the error (A). It therefore, seems that the distractor (A) did not function.

(ii) Only 2% First divisioners, 0% Second divisioners, 11% third divisioners and about 8% failures committed the error (B). Hence this distractor (B) also did not function.

It is to be noted further that intelligent candidates (I and II divisioners) do not commit the errors of the type (A) and (B).

(iii) About 4% first divisioners, 25% second divisioners, 19% third divisioners and 25 % failures committed the error (D). It is a satisfactory distractor and has functioned well in comparison to (A) and (B). In conclusion we can say that it is a common error, though I divisioners commit this error rarely.

The percentage of successful candidates, who answered it correctly satisfy the inequality.

First Div. > II Div. > III Div. > Failures.

From all these facts we can discuss that the question was not well framed, the distractors were unsatisfactory.

Q.No. 2 Topic - Percentage

The decimal form of 47 % is -

Objective - Knowledge

Expected Errors

(A) $47\% = \frac{47}{1000} = .047$,

(B) $47\% = \frac{47}{10} = 4.7$,

(D) $47\% = \frac{47}{1} = 47$.

STATISTICAL DATA

Category	Distractor A	B	C	D	Omitted	Total
First divisioner	1	48	1	1	-	51
Second Divisioner	7	66	2	-	1	76
Third divisioner	13	69	14	4	2	102
Failure	16	32	13	7	3	71
Total	37	215	30	12	6	300
Percentage	$12\frac{1}{3}\%$	$71\frac{2}{3}\%$	10%	4%	2%	100%

The distractor showing correct answer to the question is (B)

INTERPRETATION OF THE DATA:

From the statistics we observe that

(1) Only 2% first divisioners, 9% second divisioners, 13% third divisioners and $22\frac{1}{2}\%$ failures committed the error (A). The error committers among the first and second divisioners are about $6\frac{1}{2}\%$ only, whereas third divisioners and failures count to about 16.7%. It shows that intelligent candidates rarely commit this error, it is a common error of weak students. It is not a very good distractor.

In this question also the percentage of different categories who choiced for the correct distractor satisfy the inequality.

First divisioners > Second divisioners > III Divisioners > Failures

(11) About 2% first divisioners, 3% second divisioners, 14%

third divisioners and about 18% failures committed the error (C), it also shows that the first and second divisioners have committed this error rarely, (only $2\frac{1}{9}$ % of them) third divisioners and failures have also committed to the count of 16% nearly only. Hence we can say this is also not a good distractor. It cannot be considered a common error of all the candidates.

(iii) The maximum number of candidates who committed the error (D) are from the category of failures and their percentage is 10. The percentage of the candidates from other categories is less than 4.

On the whole this question is not properly framed.

Q.No. 3 Topic - Compound interest

Objective - Knowledge

Effected Errors - The question is to find the compound interest for 4 years on Rs.1,000/-, @ 10% per year.

(A) Finds amount $1000\ (1 + \frac{10}{100})^4$ instead of compound interest.

(B) Instead of substracting Rs.1,000/- from the amount, one substracts only Re.1/- and writes Interest = Rs. $\{1000(1+\frac{10}{100})^4 - 1$

(D) Write Rs. $\{1000 - (1 + \frac{10}{100})^4\}$ as compound interest.

STATISTICAL DATA

Category	Distractors A	B	C	D	Omitted	Total
First divisioner	14	1	35	1	-	51
Second divisioner	32	6	37	1	-	76
Third divisioner	43	8	49	2	-	102
Failure	40	3	16	7	5	71
Total	129	18	137	11	5	300
Percentage	43%	6%	$45\frac{2}{3}$%	$3\frac{2}{3}$ %	$1\frac{2}{3}$ %	100 %

INTERPRETATION OF THE DATA

These statistics show that

(i) Students committing error A are 7% I divisioners, 42% II divisioners, 43% III divisioners and 57% failures nearly. It shows that it is a good distractor, and has functioned quite well. Thus we can say it is a common error of the candidates.

(ii) 2% First divisioners, about 8% second divisioners, 8% third divisioners and about 4% failures committed the error of the type (B). Obviously this distractor has not functioned well i.e. it cannot be considered to be a common error of the candidates.

(iii) Similarly only 2% I divisioners, 1.3% second divisioners, 2% third divisioners and about 10% failures committed the error (D). It, therefore also shows that this distractor is a weak distractor and is not a common error.

On the whole we can conclude that distractors B and D need some improvements.

Q.No. 4 Topic - Profit and loss

Objective - Knowledge

Expected Errors

In this question selling price and percentage of profit are given and the cost price is demanded.

(i) In the error A, one may calculate cost price as $\frac{\text{selling price} \times \text{percentage of profit}}{100}$ i.e. which actually is the profit on selling price with the given percentage of profit.

(ii) In the error B, one may find cost price as

i.e. selling price $\times \frac{115}{100}$

which obviously is greater than the selling price and actually it does not calculate the cost price, since cost price is greater than selling price only when there is a loss. In the solution of this question one has to use the figures 675, 115 and 100 in the form $675 \times \frac{100}{115}$ and it is quite likely that one may mistake in placing the figures 100 and 115 and in the confused state of mind he may choose distractor B as the answer. 'C' is the correct distractor.

(iii) In distractor D, it is expected that one may proceed to calculate cost price by taking loss instead of 15% profit i.e. one may use the figure 85 in place of 115 and choose the answer as

$$\text{Rs.}675 \times \frac{100}{85}.$$

STATISTICAL DATA

Category	Distractors A	B	C	D	Omitted	Total
I	1	7	43	-	-	51
II	1	23	51	1	-	76
III	11	34	51	4	2	102
Failures	9	36	23	3	-	71
Total	22	100	168	8	2	300
Percentage	$7\frac{1}{3}$%	$33\frac{1}{3}$%	56%	$2\frac{2}{3}$ %	$\frac{2}{3}$ %	100 %

INTERPRETATION OF THE DATA

From these statistics we observe that -

(i) The options for distractor A are 2% I, $1\frac{1}{3}$% II, 11% III and $12\frac{2}{3}$% failures. It shows that it is not a common error of intelligent candidates i.e. I and II divisioners but is a common error of weak students like III divisioners and failures. It cannot be considered to be a very good distractor.

(ii) The options for error B are 14% I, about 30% II, 34% III and about 50% failures. Naturally it has proved to be a common error. It is a nice distractor.

(iii) The options for the error D are 0% I, $1\frac{1}{3}$% II, 4% III and about 4% failures. Obviously it is a weak distractor and it is not a common error.

In reality for the answer of this question one has to use the ~~figures~~ figures 675, 115 and 100 in one or the manner. This is why distractors A and D did not function.

Q.No. 5 Topic - Relative speed

Objective - Knowledge

Expected Errors - The correct formula is (6 + 4) x 5 kms. given in distractor B.

(i) One may choose - (6 - 4) x 5kms. instead of (6 + 4) X 5 km ~~which~~ which is the answer if they proceed in the same direction. It is the distractor (or error) A.

(ii) One may choose (6 x 4) x 5 i.e. + operation is confused with X operation which actually happens rarely. It is the distractor C or we name it as error 'C'.

(iii) Similar to error 'C' one confuses + operation with $\div$ operation and chooses answer (6 $\div$ 4) x 5 kms. which also usually does not happen, and this fact will be clear from the collected statistics.

STATISTICAL DATA

Category	Distractor A	B	C	D	Omitted	Total
I	3	48	-	-	-	51
II	18	57	1	-	-	76
III	19	81	1	-	1	102
Failure	21	42	4	2	2	71
Total	61	228	6	2	3	300
Percentage	$20\frac{1}{3}$ %	76 %	2 %	$\frac{2}{3}$ %	1 %	100 %

INTERPRETATION OF THE DATA

It is clear from these statistics that choices are mostly distributed for the distractors A and B. For D, it is almost nil and for C it is negligible. Thus distractors C and D did not function at all. We can therefore, say that the purpose of this question as multiple choice is completely defeated. Working distractors are only two A and B, hence 50% chances were therefore each. Since B is correct, much diviation remained for B.

In calculating the relative speed, working operations are + and -. The distractors formed by x and ÷ are superfluous and it is this reason that the distractors C and D did not function.

Thus errors C and D are not common errors. The only common error is A.

Q.No. 6 Topic - Work and time

Objective - Knowledge

Expected Errors - Correct answer is $\frac{1}{30} + \frac{1}{20}$ as given in distractor C.

(1) Finds $\frac{1}{20}$ only which is one day's work of Sohan i.e.

misses to include one day's work of Mohan. It is distractor (error) A.

(ii) Finds $\frac{1}{30}$ only which is one day's work of Mohan and misses to include one day's work of Sohan. It is distractor (error) B.

(iii) Finds difference of one day's work of both i.e. $\frac{1}{20} - \frac{1}{30}$.

STATISTICAL DATA

Categories	Distractors A	B	C	D	Omitted	Total
I	-	-	51	-	-	51
II	1	1	72	2	-	76
III	2	-	95	3	2	102
Failure	-	-	69	2	-	71
Total	3	1	287	7	2	300
Percentage	1%	$\frac{1}{3}$%	$95\frac{2}{3}$%	$2\frac{1}{3}$ %	$\frac{2}{3}$ %	100 %

INTERPRETATION OF THE DATA

From the statistics it is quite clear that it has completely thwarted the purpose of the multiple choice question. The only functioning distractor is the correct answer 'C'.

The reason which we observe is, " when one day's joint work is asked it should involve figures for each of them which is not so in distractor A and B. Another reason is, "For the joint work only + operation is effective", it is why the distractor D did not function. The - operation is ineffective because one day's joint work cannot be less than one day's individual work, which happens when we take $\frac{1}{20} - \frac{1}{30}$ as given in distractor D.

Thus none of the errors A, B and D is a common error.

Q.No. 7 Topic - Time, work and wages.

Objective - Understanding

Expected Errors - The answer given in distractor A is correct.

(i) One may divide the amount equally between them without considering the share of their work and finds Rs.45/- as Ram's share as given in distractor B.

(ii) One may find Moti's share in place of Ram's and chooses the distractor (error) C.

(iii) One may consider Ram's share = Total amount - No. of days in which Moti completes the work is Rs.90 - Rs.20 = Rs.70/- which is the distractor D.

STATISTICAL DATA

Category	Distractors A	B	C	D	Omitted	Total
I	24	2	25	-	-	51
II	33	3	39	-	1	76
III	33	16	47	3	3	102
Failure	16	18	29	4	4	71
Total	106	39	140	7	8	300
Percentage	$35\frac{1}{3}\%$	13%	$46\frac{2}{3}\%$	$2\frac{1}{3}\%$	$2\frac{2}{3}\%$	100 %

INTERPRETATION OF THE DATA

From these data it is obvious that A and C functioned very well. The distractor B functioned a bit but the distractor D did not functioned at all. The way, the distractor ~~xxxxxxx~~ D has been derived, makes, it dis-functional. Moreover, if Ram's share is Rs.70/- then Moti's

share remains Rs.20/- only, which shows a vast difference between their shares. Ram's share is more than three times Moti's share, which is not justified from the given data. The data only reflect that Ram's and Moti's work are not exactly equal but almost equal. Hence such a difference makes their mind not to opt for it as answer.

Distractor B and C are common errors, whereas D is not a common error.

Item No. 8 Topic - Ratio and proportion

Objective - Understanding

Expected Errors - Given A:B :: 6:7, B:C :: 14:17; to find A:B:C

(i) finds A:B:C :: 6:7:17 (distractor A)

(ii) finds A:B:C :: 6:14:17 (distractor B)

(iii) finds A:B:C :: 6:(7+14):17 i.e. 6:21:17 (distractor D)

The correct answer is 12:14:17.

STATISTICAL DATA

Category	Distractors A	B	C	D	Omitted	Total
I	2	6	39	3	1	51
II	10	13	36	13	4	76
III	17	19	40	18	8	102
Failure	20	15	8	19	9	71
Total	49	53	123	53	22	300
Percentage	$16\frac{1}{3}\%$	$17\frac{2}{3}\%$	41%	$17\frac{2}{3}$	$7\frac{1}{3}\%$	100 %

INTERPRETATION OF THE DATA

We only conclude that all the distractors are nice and have functioned very well, though first divisioners committed the errors rarely.

Thus all the expected errors are common errors.

Q.No. 9 Topic - Average

Objective - Knowledge

Expected Errors - The correct answer is Rs.40/- which is the distractor B.

(i) In stead of finding the average one may determine the common difference Rs.10/- and therefore gives option for distractor A(error ..).

(ii) One may find average as $\frac{50+40+30}{2}$ = 60 and hence makes the choice for distractor C.

(iii) One may find the average as sum of the quantities i.e. 50+40+30 = 120g and therefore selects distractor D as his answer.

STATISTICAL DATA

Category	Distractors A	B	C	D	Omitted	Total
I	-	50	1	-	-	51
II	-	73	-	3	-	76
III	-	96	4	2	-	102
Failure	2	55	6	8	-	71
Total	2	274	11	13	-	300
Percentage	$\frac{2}{3}$%	$91\frac{1}{3}$%	$3\frac{2}{3}$%	$4\frac{1}{3}$ %	-	100%

INTERPRETATION OF THE DATA

It is very clear from these statistics data that only functional distractor is B (the correct answer). There may be two reasons for it (i) candidates prepared the topic of average very well and hence arrived at correct answer i.e. chose the distractor B.

(ii) A, C and D were poor distractors and therefore candidates were prompted to opt the distractor B only. It is a fact that the average of certain numbers lies between the least and the greatest of them. Might be that the candidates had this concept and since none of the distractors A, C and D satisfy this condition they could only have the choice for B.

It is, therefore, clear that this question did not serve the purpose. Its framing is very poor. None of the errors A, C and D is a common error.

Q.No. 10 Topic - Square root and cube root

Objective - Understanding

Expected Errors - The distractor A gives the correct answer.

(i) One may only find the cube root of 64 = 4 and therefore makes a choice of distractor B.

(ii) One may only find the square root of 64 = 8 and therefore makes a choice for distractor C.

(iii) One may find square root of cube root of 64 = $\frac{64}{\text{cube root of } 64}$ = $\frac{64}{4}$ = 16 and therefore opts distractor D for this answer.

STATISTICAL DATA

Category	Distractors A	B	C	D	Omitted	Total
I	35	12	4	-	-	51
II	37	25	14	-	-	76
III	37	30	33	2	-	102
Failure	15	18	36	2	-	71
Total	124	85	87	4	-	300
Percentage	$41\frac{1}{3}\%$	$28\frac{1}{3}\%$	29%	$1\frac{1}{3}\%$	-	100%

INTERPRETATION OF THE D.T.

A, B and C are very good distractors, whereas D is very poor distractor which did not function at all.

Since distractor D involved operation of division which neither happens in square root nor in cube root hence made the candidates inclined to leave it unopted, it is why it did not function. This distractor requires some improvement. Distractors B and C are common errors; and distractor D is not a common error.

M.No. 11 Topic - Logarithms

Objective - Knowledge

Expected Errors - The correct answer is n log m as given in distractor D.

(i) Distractor A is $\log \frac{m}{n}$, one can get this answer if one thinks $m^n = \frac{m}{n}$. Hence it is the error A.

(ii) If one imagines that m^n is a misprint and it is actually mn then he will commit the error of choosing distractor B.

(iii) Of m, n; m comes first in alphabetical order, one may be tempted to write hurridly $\log m^n = m \log n$. It is the third error, say error 'C', if one chooses $m \log n = \log m^n$ i.e. the distractor C.

STATISTICAL DATA

STATISTICAL DATA

Categories	Distractors A	B	C	D	Omitted	Total
I	2	6	6	37	1	51
II	8	7	14	46	2	76
III	20	11	16	51	4	102
Failure	30	11	7	19	4	71
Total	60	34	43	153	11	300
Percentage	20%	$11\frac{1}{3}$%	$14\frac{1}{3}$%	$50\frac{2}{3}$%	$3\frac{2}{3}$%	100 %

INTERPRETATION OF THE DATA

All the distractors of this question have functioned well. It shows, "how much ignorant about the knowledge of m^n the candidates were?" $m^n = \frac{m}{n}$ or mn is quite absurd. It is a question of the recall of formula. This performance shows that candidates did not prepare the Chapter of Logarithms well and most of them left it in choice.

All the expected errors are common errors.

Q.No. 12 Topic - Sets

Objective - Understanding

Expected Errors - The distractor C is the correct answer.

(i) First error - one may consider $\{0\}$ as a void set (distractor A).

(ii) Second error - one may consider $?$ as a void set (distractor B).

(iii) Third error (distractor D) - one may consider as a void set.

STATISTICAL DATA

Categories	Distractors A	B	C	D	omitted	Total
I	-	14	36	1	-	51
II	6	28	41	3	1	76
III	4	43	49	6	-	102
Failures	5	23	35	4	4	71
Total	15	103	161	16	3	300
Percentage	5%	$34\frac{1}{3}$%	$53\frac{2}{3}$%	$5\frac{1}{3}$%	$1\frac{2}{3}$%	100 %

INTERPRETATION OF THE DATA

From the statistics it is clear that this question has failed to serve the purpose of a multiple choice question. Only working distractors are B and C. Distractors A and D are useless. Candidates are informed ϕ or $\{\}$ as symbols of a void set. Out of these two, ϕ is used more frequently. Because symbol ϕ has not appeared any where in the distractors, some candidates got confused it with $\{\phi\}$ and then made choice for the distractor B, and it being known to them that the symbol $\{0\}$ stands for a singleton set with one element 0, or if one did not remember it, then also in the presence of $\{\}$ and $\{\phi\}$, it and $\{\{\}\}$ looked quite French to them. It is why these distractors remained useless.

Distractor B is a common error, whereas A and D are not common errors.

Q.No. 13 **Topic** - Simple equations

Objective - Knowledge

Expected Errors - The distractor B is the correct answer.

(i) First error (A) - one calculate $x = \frac{10}{5} = 2$ (distractor A)

(ii) Second error (C) - One computes x = 10 x 5 = 50 (distractor C)

(iii) Third error (D) - One finds x = 10 x 6 = 60 (distractor D).

Statistical Data

Categories	Distractors A	B	C	D	Omitted	Total
I	1	50	-	-	-	51
II	4	66	2	2	2	76
III	11	77	2	8	4	102
Failures	7	49	9	5	1	71
Total	23	242	13	15	7	300
Percentage	$7\frac{2}{3}$%	$80\frac{2}{3}$%	$4\frac{1}{3}$ %	5 %	$2\frac{1}{3}$%	100 %

INTERPRETATION OF THE DATA

Only functioning distractor is B. Thus it has totally failed in achieving the purpose of multiple choice, i.e. it has failed in its testing objective.

In such questions, candidates usually verify the given equation from the given answers. None except 10 will satisfy this equation. It is, therefore, a defective question. Rather we can say, such equations should not be asked in multiple choice questions. Thus none of the errors A, C and D is a common error.

Q.No. 14 Topic - Trigonometrical ratios

Objective - Understanding

Expected Errors - Distractor C is the correct answer.

(i) Error (A) - One takes cos θ as the inverse of sin θ

(ii) Error (B) - One takes sec θ as the inverse of sin θ

(iii) Error (D) - One takes tan θ as the inverse of sin θ

STATISTICAL DATA

Categories	Distractors A	B	C	D	Omitted	Total
I	7	3	40	1	-	51
II	14	6	52	4	-	76
III	27	10	58	5	2	102
Failures	25	11	26	6	3	71
Total	73	30	176	16	5	300
Percentage	$24\frac{1}{3}\%$	10%	$58\frac{2}{3}\%$	$5\frac{1}{3}\%$	$1\frac{2}{3}\%$	100 %

INTERPRETATION OF THE DATA

Distractors A and B are common errors. Distractor D is not a common error. The distractor D did not function. It is, therefore, not a very good question.

The candidates might have been confused cosec θ with sec C and therefore might have chosen the distractor B. Similarly, since $\sin^2\theta + \cos^2\theta = 1$, candidates without understanding the correct meaning of 'inverse', might have considered cos C as inverse sin θ. In no standard formula, only sin θ and tan θ gives unity, hence the distractor D could not attract the candidates to opt for it as answer.

NO. 16 Topic - Problems in equations

Objective - Understanding

Expected Errors - The distractor A is the correct answer.

(i) Error B (distractor B) - One may form the equation as $x^2 + x = 42$.

(ii) Error C (distractor C) - One may form the equation $x^2 - x = 42$

(iii) Error D (distractor D) - One may form the equation $x^2 \div x = 42$

STATISTICAL DATA

	Distractors					
Categories	A	B	C	D	Omitted	Total
I	41	5	5	-	-	51
II	49	5	21	1	-	76
III	61	10	28	4	1	102
Failures	36	8	23	2	2	71
Total	186	28	77	7	3	300
Percentage	$61\frac{2}{3}\%$	$9\frac{1}{3}\%$	$25\frac{2}{3}\%$	$2\frac{1}{3}\%$	1%	100%

INTERPRETATION OF THE DATA

DISTRACTOR d is not a common error, whereas B and C are common errors.

It is obvious from these figures that working distractors are A, B and C. Among these only A and C have functioned properly, B has not functioned well.

A candidate of this standard at least knows that for the phrases "less than" and "greater than", only two operations - and + are used. Operations x and ÷ are used only when one thing is a multiple of the other. This is why the distractor B could not attract the candidates. The most appropriate operation for this question is - and therefore the distractor B with operation + also could not function well.

Q.No. 16 Topic - The values of t-ratios in relation to the values of some particul t-ratio.

Objective - Understanding

Expected Errors - The distractor A ($\frac{3}{4}$) is the correct answer.

From given $\cos \theta = \frac{4}{5}$, one takes two sides as 4 and 5 respectively and finds third as 3 there.

(i) takes $\tan \theta = \frac{3}{5}$, the distractor B (error B)

(ii) takes $\tan \theta = \frac{4}{5}$, the distractor C (Error C)

(iii) takes $\tan \theta = \frac{4}{3}$, the distractor D (errord D)

STATISTICAL DATA

Categories	Distractor A	B	C	D	Omitted	Total
I	25	6	15	4	1	51
II	24	28	13	9	2	76
III	30	22	33	12	6	102
Failures	17	17	24	10	3	71
Total	96	73	85	35	11	300
Percentage	32%	$24\frac{1}{3}$%	$28\frac{1}{3}$%	$11\frac{2}{3}$ %	$3\frac{2}{3}$%	100 %

INTERPRETATION OF THE DATA

The data show that all the distractors have functioned well. But it is quite strange to note that about 28% candidates have not made any distinction between cos θ and tan θ, as they have answered distractor C. We, therefore, can only infer that candidates have merely gambled in answering this question. It is just possible that they might have thought tan θ to be less than unity. It can only explain why the least number of candidates have answered the distractor D. The candidates might not have prepared this part of the syllabus for the examination.

Thus distractors B, C and D are all common errors.

Q.No. 17 Topic - Relation between area of a triangle and a rectangle situated on the same base and between the same parallels.

Expected Errors - The distractor B is the correct answer.

(i) Error A - The area of a rectangle = Area of the triangle

(ii) Error C - The area of a rectangle = 3 X Area of the triangle.

(iii) Error D - The area of a rectangle = 4 x Area of the triangle.

STATISTICAL DATA

	Distractor					
Categories	A	B	C	D	Omitted	Total
I	1	48	1	-	1	51
II	11	52	7	6	-	76
III	21	45	16	16	4	102
Failures	17	17	24	10	3	71
Total	50	162	48	32	8	300
Percentage	$16\frac{2}{3}\%$	54%	16%	$10\frac{2}{3}\%$	$2\frac{2}{3}\%$	100%

INTERPRETATION OF THE DATA

These data make it clear that first divisioners have not committed any of these errors. Thus A, C and D are common errors of II divisioners, III divisioners and failures. More than 75% failures, 55% III divisioners and 32% II divisioners committed these errors.

Q.No. 18 Topic - Area of walls of a room.

Objective - Application

Expected Errors - Distractor A (60 sq. meter) is the correct answer.

(i) One may consider the wall 12 x 6 as a smaller wall and hence may choose distractor B i.e. 72 sq. m. as his answer.

(ii) One may consider the floor 12 x 10 as a smaller wall and thus write distractor C i.e. 120 sq. m. as his answer.

(iii) One may write the area of four walls i.e. 2(12 + 10)x 6 sq. m. as his answer in place of area of a smaller wall, the distractor D.

STATISTICAL DATA

Categories	Distractor A	B	C	D	Omitted	Total
I	13	6	11	20	1	51
II	8	15	5	48	-	76
III	4	20	10	67	1	102
Failures	1	12	7	47	4	71
Total	26	53	33	182	6	300
Percentage	$8\frac{2}{3}\%$	$17\frac{2}{3}\%$	11%	$60\frac{2}{3}\%$	2%	100%

INTERPRETATION OF THE DATA

These data bring out an astonishing fact that only $8\frac{2}{3}\%$ could understand and answer the question correctly, $60\frac{2}{3}\%$ took it as a question for the area of four walls and they answered the distractor D. Rest of the candidates answered either B or C, which means they answered the question at random without following the question. All these facts show that the candidates did not have time to think over the problem but they chose any distractor at random for its answer.

Thus all the wrong distractors are common errors and most frequent error in this question is distractor D.

Q.No. 19 Topic - Partnership

Objective - Understanding

The correct answer is Rs.750/- .

STATISTICAL DATA

	I	II	III	Failures	Total	Percentage
Correct	46	70	74	45	235	78 1/3 %
Incorrect	5	6	28	24	63	21 %
Omitted	-	-	-	2	2	2/3 %
Total	51	76	102	71	300	100%

INTERPRETATION OF THE DATA

From these data it follows that partnership was followed by a majority of candidates of all categories.

Q.No. 20 Topic - Profit and loss

Objective - Understanding

The correct answer is Rs.6,000/-.

STATISTICAL DATA

	I	II	III	Failures	Total	Percentage
Correct	38	51	38	20	147	49 %
Incorrect	13	23	58	50	144	48 %
Omitted	-	2	6	1	9	3 %
Total	51	76	102	71	300	100 %

INTERPRETATION OF THE DATA

We observe that 75% first divisioners and 70% second divisioners could answer this question correctly whereas only 37.2% III divisioners and 28% failures answered it correctly. It means I and II divisioners prepared this chapter nicely.

Q.No. 21 Topic - Volume of a rectangular cuboid (Application).

STATISTICAL DATA

	I	II	III	Failure	Total	Percentage
Correct	20	11	12	2	45	15 %
Incorrect	29	53	81	58	221	74 %
Omitted	2	12	9	11	34	11 %
Total	51	76	102	71	300	100 %

INTERPRETATION OF THE DATA

From the data it becomes obvious that this portion of the syllabus has remained neglected by the candidates. Only a few candidates could answer it correctly. It is a question on application. These figures show that only first divisioners could attempt it well.

Q.No. 22 Topic - Values of trigonometrical ratios for standard angles.

STATISTICAL DATA

	I	II	III	Failures	Total	Percentage
Correct	18	14	6	1	39	13 %
Incorrect	29	51	71	48	199	66 %
Omitted	4	11	25	22	62	21 %
Total	51	76	102	71	300	100 %

INTERPRETATION OF THE DATA

From the data we can say that only I and II divisioners had little preparation of this topic. III divisioners and failures had no preparation. Though this question is of simple knowledge, but the students' performance was very poor.

Q.No. 23 Topic - Logarithms (Application)

STATISTICAL DATA

	I	II	III	Failure	Total	Percentage
Correct	-	-	-	-	-	0 %
Incorrect	46	57	70	48	221	74 %
Omitted	5	19	32	23	79	26 %
Total	51	76	102	71	300	100 %

INTERPRETATION OF THE DATA

None answered it correctly. No student could understand this topic. This question is actually based on the definition of logarithms, but required the knowledge

of the solution of indicial equations which is not in their syllabus and indirectly it becomes a question out of their syllabus.

Q.No. 34 Topic - Set theory (Understanding)

STATISTICAL DATA

	I	II	III	Failure	Total	Percentage
Correct	34	44	36	21	135	45 %
Incorrect	16	30	52	36	134	45 %
Omitted	1	2	14	14	31	10 %
Total	51	76	102	71	300	100 %

INTERPRETATION OF THE DATA

These data show that only 45% of the candidates were knowing the concept of universal set. In the different categories we observe that 68% of I divisioners, about 60% of II divisioners, 36% (about) of third divisioners and 30% of failures answered it correctly. The question is a little defective also, since for these four sets we may choose universal set in infinity of ways, e.g. A set $\{1,2,3,4,5,6,7,8,9\}$ may also considered as universal set for this class of sets $\{1,2,3,4\}$, , $\{2,3,4\}$, $\{4\}$, $\{4,5\}$.

On the basis of the analysisof the data mentioned above, a list of the Kernel and Consequential errors compiled topicwise is given in Appendix 'A'.

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CHAPTER - FOURTH

ANALYSIS AND INTERPRETATION OF DATA OF SECTION-B (CONSISTING OF ESSAY TYPE AND SHORT ANSWER TYPE QUESTIONS)

The following description shows the analysis of the questions and the interpretation of the statistical data collected for the common errors as noted from the sample of 300 candidate including 51 first divisioners, 76 second divisioners, 102 third divisioners and 71 failures.

Many of the errors discussed are the mistakes of the mathematical language and the rest are in the concepts of the subject.

For remedying these common errors, the following measures are suggested :

1) The teacher, while giving solution of problems in illustrations, should inform the candidates about these common errors.

2) He (the teacher) should then check that the candidates do not commit these errors while solving the questions. He should carefully check the home work and if any candidate commits any of these errors, he should be asked to repeat the solution with care so that no such error is repeated.

3) We may take particular care of these errors while checking the test answer books and warn the individual candidate of the errors which still remain in the solutions.

At first sight some errors might seem to be very light but these errors lead to very serious errors in consequences.

Question No. 1(a) Analysis

Unit - Factors of the form $(a+b)^2 = a^2 + 2ab + b^2$

Objective : Understanding

Question - Factorise $25x^4 + 20x^2y^2 + 4y^4$

Steps to be taken in the solution

1. $= (5x^2)^2 + 2.5x^2 .2y^2 + (2y^2)^2$
   $= (5x^2 + 2y^2)^2$

Or

2. $= 25x^4 + 10x^2y^2 + 10x^2y^2 + 4y^4$
   $= 5x^2(5x^2 + 2y^2) + 2y^2(5x^2 + 2y^2)$
   $= (5x^2 + 2y^2).(5x^2 + 2y^2) = (5x^2 + 2y^2)^2$

Possible errors :-

1. One does not use the sign of equality between two different steps in the solution.

2. One does not use the sign of addition between two terms of an expression.

3. One is unable to express equivalent terms e.g. one writes $4y^4 = 2(y^2) = (2y)^2$ or $4y^2 = (2y^2)^2 = 2(y^2)^2 = (2y)^2$ etc.

4. One is unable to write factors.

5. One writes the answer as $(5x + 2y)^2$ or $5x + 2y^2$ in place of the correct answer $(5x^2 + 2y^2)^2$.

Frequency distribution for these errors

Category	Error No. 5						Not Attempted.	Attempted.	Irrelevant
	1	2	3	4	5	6			
I	12	5	2	1	1	1	18	33	3
II	27	6	8	5	1	5	34	42	8
III	39	11	18	27	2	4	45	57	14
Failures	20	1	13	11	3	1	34	37	15
Total	89	23	33	44	7	11	131	169	41
Percentage	52.7	13.6	19	26	4	6.5	43.7	56.3	13.7

Data in terms of percentage :

Category	Error No.					
	1	2	3	4	5	6
I	36	16	6	3	3	3
II	64	15	19	12	2.4	12
III	63	20	19	47.4	3.5	7
Failure	54.5	3	35	29.7	8	2.7

INTERPRETATION OF THE DATA

These data show that error No. 1 , 2, 3 and 4 are common errors and error No. 5 and 6 are not the common errors. Candidates of all categories have committed each of these errors.

It is obvious that first divisionars commit errors No. 3,4,5 and 6 very rarely.

The first error is the error of the mathematical language and the rest of the errors are the errors of the concepts.

QUESTION No. 1(b)

Unit- Factors of the form $x^2 - y^2$ i.e. difference of two squares.

Objective - Understanding

Question- Factorize $x^2 - 49y^2$

Steps to be taken in the solution

i) expressing in the form = $x^2 - (7y)^2$

ii) writing the factors = (x + 7y) (x -7y)

POSSIBLE ERRORS -

1. One does not use the sign of equality.

2. One does not use the sign of addition or subtraction between terms of an expression.

3. One is unable to express equivalent terms $(7y)^2 = 7y^2$

4. One is unable to write factors.

5. One writes " taking square root, we have "

FREQUENCY DISTRIBUTION FOR THESE ERRORS :

Category	Error No.					Not attempted.	Attempted.	Irrelevant.
	1	2	3	4	5			
I	21	-	6	4	1	9	42	-
II	35	-	3	19	-	16	60	4
III	49	-	18	11	-	26	76	12
Failure	30	3	20	17	-	24	47	19
Total	135	3	47	41	1	75	225	26
Percentage	60	1.3	21	18	.4	25	75	12

The percentage of candidates who committed these errors are shown in the following table :

Data in terms of percentage

Category	Error No.				
	1	2	3	4	5
I	50	-	14.3	1	2
II	58.3	-	5	16	-
III	64.5	-	23.6	14.5	-
Failure	64	6.4	42.5	36.2	-

INTERPRETATION OF THE DATA :

From the data it is obvious that error Nos. 1, 3 and 4 are the common errors and error No. 2 and 5 are not the common errors.

Errors No. 3 and 4 are related to each other. One who commits error No. 3, usually commits error No. 4 also. There were only a few candidates who committed error No. 3 but finally wrote the factors correctly.

Question No. 1 (c)

Unit- Factorization by method of grouping.

Objective- Understanding

Question- Factorize $x^3 + x + x^2 + 1$

Steps to be taken in the solution :

1. Grouping of terms i.e. = $(x^3 + x) + (x^2 + 1)$

2. Taking common factor from each group of terms = $x(x^2 + 1) + 1(x^2 + 1)$.

3. Writing factors = $(x^2 + 1)(x + 1)$

Possible Errors :

1. One does not use the sign of equality between two different steps in the solution.

2. One does not use the sign of addition between two terms of an expression.

3. One is unable to group the terms correctly.

4. One is unable to factorize each group or terms.

5. One is unable to write factors.

Frequency distribution of these errors :

Category	Error No. 1	2	3	4	5	Not attempted.	Attempted.	Irrelevant.
I	23	5	0	1	0	11	40	0
II	28	14	3	5	2	26	50	6
III	49	19	7	10	8	37	65	7
Failure	27	7	12	18	21	32	39	5
Total	127	45	22	33	31	106	194	18
Percentage	65.8	23.7	11.3	17	16			

Data in terms of percentage :

Category	Error No. 1	2	3	4	5
I	57.5	12.5	0	2.5	0
II	56	28	6	10	4
III	75.4	29.2	10.8	15.4	12.3
Failure	69.2	18	30.7	46.2	53.8

INTERPRETATION OF THE DATA :

On the basis of these data, it can be said that all these errors are the common errors of the candidates. It is also clear from these data that error No. 3,4 and 5 are not the common errors of first and second divisioners. These are common errors committed by third divisioners and failures only. Thus we may say that the first and second divisioners do not mistake in grouping the terms for factorizations and in factorizing each group of terms correctly. They also do not make any error in writing the final factors correctly. The mistakes only occur with third divisioners and failures.

Question No. 1 (d)

Unit- Factorization of trinomials.

Question- Factorize $2 + 5x + 3x^2$.

Objective- Understanding.

Solution- With necessary steps :

i) Expressing in the form = $2+3x+2x + 3x^2$ or
$= 2 + 2x + 3x + 3x^2$

ii) Forming pairs = $(2 + 3x) + (2x + 3x^2)$ or
$+ (2 + 2x) + (3x + 3x^2)$

iii) Factorizing each group = $(2 +3x) +(2 +3x)$ or
$= 2(4 +x) + 3x(= 1 + x)$

iv) writing factors = (2 + 3x) (= = 1 + x)

or = (= 1 + x) (2 + 3x).

Possible errors :

1. One does not use the sign of equality between two different steps in the solution.

2. One does not use the sign of addition between the terms of an expression.

3. One is unable to split up or break up 5x into 2x + 3x.

4. One is unable to group the terms correctly.

5. One is unable to factorize each group of terms.

6. One is unable to write factors.

Frequency distribution of these errors :

Category	Error No. 1	2	3	4	5	6	Not Attempted.	Attempted	Irrelevant
I	19	8	7	9	9	4	16	35	1
II	24	9	6	5	5	2	34	42	4
III	36	17	2	7	15	10	81	51	3
Failure	22	7	16	15	16	15	45	26	3
Total	101	41	31	36	47	31	146	154	11
Percentage	65.6	26.6	20	23.4	30.5	20	48⅔	51⅓	7.1

Data in terms of percentage

Category	Error No. 1	2	3	4	5	6
I	84.3	22.3	20	25.7	25.7	11.4
II	57.1	21.4	14.3	11.9	11.9	48
III	73.6	33.3	3.9	13.7	29.4	19.6
Failures	84.6	26.9	61.5	57.7	69.2	57.7

INTERPRETATION OF THE DATA

From the data it is clear that all these errors are the common errors of the candidate.

CONCLUSION :

In conclusion for factorization the following are the findings.

1. Candidates of all categories miss to write the sign of equality between two different steps of the solution and e.g. writes the solution 1(a) as

$$25x^4 + 20x^2y^2 + 4y^4$$
$$(5x^2)^2 + 20x^2y^2 + (2y^2)^2(5x^2 + 2y^2)^2$$

½ K - if there is no other mistake committed.

2. Candidates of all categories miss to write the sign of addition or subtraction between two terms of

an expression e.g. writes the solution of $f(x)$ as

$$x^2 + x + x^2 + 1 = x(x^2+1)(x^2+1)$$
$$= (x^2+1)(x)$$

which shows that it leads to other errors also. This error is committed rarely in the problems of factorization of differences of two squares.

3. It is observed that candidates of all categories make errors in writing equivalent terms such as

$49y^4 = (7y^2)^2 = 7(y^2)^2$ or $7y^2 = (7y)^2$ etc.

4. When there is a problem of factorization by grouping of terms, candidates usually make error in grouping the terms.

5. Candidates some times show the ignorance of the knowledge of factorization of the expressions such as $x^3 + x$ in the form of $x(x^2 + 8)$ etc.

6. It has also been observed from the above discussions that in the problems of factorization after taking first a few correct steps, the candidates cannot write the final factors.

Question No. 2

Unit- Cube root of rational numbers

Question- Find the cube root of $2\frac{19}{27}$

Objectives: Knowledge

Solution with necessary steps (i.e. processes involved)

1. Conversion of $2\frac{10}{27}$ in the form $\frac{54}{27}$

2. Finding square root of N^{th} and D^{th} separately as

$\sqrt[3]{64} = 4$ and as $\sqrt[3]{27} = 3$.

3. Writing $\sqrt[3]{\frac{64}{27}}$ as $\frac{4}{3}$

4. Converting $\frac{4}{3}$ into $1\frac{1}{3}$

Possible errors :

1. One does not use the symbol of cube root.

2. One does not discriminate cube root from square root.

3. One finds cube root of $\frac{a}{b}$ as $\frac{2a}{2b}$ i.e. $\frac{a}{b} = \frac{3a}{3b}$

4. One writes in the solution as

$\frac{64}{27} = \frac{4}{3} = 1\frac{1}{3}$ etc.

Statistical data i.e. (Frequency of occurence of these errors in this sample)

Category	Error No.				Not attem-	Attem- ted.	Irre- vent.
	1	2	3	4			
I	42	0	0	20	2	49	0
II	54	1	3	18	0	58	4
III	81	8	3	32	12	90	7
Failures	52	14	3	6	14	67	9
Total	229	23	9	76	36	264	20
Percentage	83.6	8.4	3.2	28.8	12	88	7.58

Data in terms of percentage :

Category	Error No.			
	1	2	3	4
I	85.7	0	0	40.8
II	79.4	1.5	4.4	26.5
III	90	8.9	3.3	35.2
Failure	81.2	24.6	5.3	10.5

INTERPRETATION OF THE DATA

From the data we observe that error No. 1 and 4 are the common errors, whereas errors No. 2 and 3 are not common errors.

Thus we can say candidates usually did not use the symbol of cube root of unity i.e. $\sqrt[3]{\ }$ either on account of

ignorance of this symbol or lack in practice of using it and usually they wrote the solution as

$$\text{cube root of } 2\frac{10}{27} = \frac{64}{27} = \frac{4}{3} = 1\frac{1}{3} \text{ Ans.,}$$

which actually has got both of these errors No. 1 and 4 involved.

Question No. 3

Unit- Simple interest.

Question- At what rate percent of interest, the sum of Rs. 600 will amount to Rs. 726 in 3 years 6 months.

Objective- Understanding.

Solution of the problem : with necessary steps. (Processes involved).

1. Finding interest = Amount - Principal = Rs. 726 - Rs. 600 = Rs. 126.

2. Converting 3 years 6 months into $\frac{7}{2}$ years.

3. Using the formula $R = \frac{I \times 100}{P \times t}\%$

where R = rate of interest , I = Interest, P = Principal, t = time in years.

4. Substituting values of I,P and t in this formula and

5. Simplifying R = 6%.

Possible errors :

1. One does not know that interest is calculated on principal.

2. One uses the formula but cannot substitute the data correctly in the formula or finds rate percent as interest on Rs. 1 for 1 year.

3. One is unable to use the formula or use unitary as law incorrectly.

4. One is unable to simply.

5. One finds interest of Rs. 100/- for ½ years and takes it as the rate percent of interest.

6. One makes error in converting 3 years 6 months into years.

STATISTICAL DATA AND THEIR INTERPRETATION

15 first divisioners, 45 second divisioners, 73 third divisioners and 60 failures did not attempt this question; the total number of candidates who attempted it were 10%.

For error 1 - there were only three candidates among third divisioners who committed this error i.e. who did not calculate interest on Principal i.e. about 10.3%

third divisionars and 2.8% in aggregate committed this type of error.

For error 2 - there were only one first divisioner, 4 third divisionars and 2 failures who committed this error. This amounts to an aggregate percentage equal to 6.6, who either could not substitute the data correctly or calculated rate percent equal to interest on Re 1 for 1 year.

No first divisioner, one second divisioners, eight third divisionars and two failures committed this error, which is equivalent to 10.2% in aggregate. It shows 10.2% of the candidates who attempted this question could not use the formula correctly.

There were to first divisioners, four second divisioners eight third divisionars and two failures who could not simplify or made error in simplication. In aggregatethey were about 18%.

There were two candidates, one second divisioner and one failure who calculated rate percent as interest of Rs. 100/- for 7/2 years. The aggregate percentage of these is 1.9.

There was only one candidate that too was a first divisioner who did mistake in converting 3 years 6 months into years.

Thus only common errors are errors No. 3 and 4. It also shows that first and second divisioners did not commit most of these errors. Failures and third divisioners committed these errors very frequently.

Question No.3 (Alternative)

Unit - Simple interest

Question- Find the simple interest on Rs. 700 for 2 years 1 month at the rate of 75 paisa per hundred per month.

Objective- Knowledge.

Process involved in the solution :

1. Conversion of 2 years 1 month into 25 months or $\frac{25}{12}$ years.

2. Conversion of 75 p. / 100 Rs. monthly into Rs. 9/- per hundred yearly or Rs. $\frac{9}{12}$ = Rs. $\frac{3}{4}$ per 100/-monthly.

3. Recalling formula $I = \frac{P \times R \times T}{100}$

4. Substitution $I = \frac{700 \times 3 \times 25}{100 \times 12}$ or $\frac{700}{100} \times \frac{3}{12} \times 25$

5. Simplification I = Rs. 146.25

Possible Errors :

1. One is unable to substitute the given data in the formula.

2. One is unable to recall the formula.

3. One is unable to simplify

4. One is unable to convert 75 p. per hundred monthly into the desired form.

5. One does not write the answer correctly.

Collected frequencies of occurrence of these error in this Sample :

Category	Error No.					Not Attempted.	Attempted.	Irrelevent.
	1	2	3	4	5			
I	-	1	1	1	-	37	14	-
II	2	4	6	9	1	31	45	-
III	5	6	10	19	4	43	59	3
Failure	1	12	18	18	13	26	45	3
Total	8	23	37	47	18	137	163	6
Percentage	4.9	17.8	28.3	28.8	11	45.7	54.3	3.6

INTERPRETATION OF THE DATA

From the data it is clear that the first divisioners do not commit these errors. Candidates commit

error No. 1 very rarely i.e. they are mostly able to substitute the data in the formula. Errors No. 2,3,4, and 5 are common errors of all the non- first divisioner candidates i.e. they usually were unable to recall the formula due to faint memory, they were weak in simplification and they mostly showed inability of converting 75 p/ Rs. 100/- monthly into the desired form. Many candidates (most of which were failures and third divisioners) after solving the problem could not write the answer correctly.

QUESTION No. 4

Unit- Compound interest

Question- The population of a city is 106400. If the population increases by 10% every year. What will be the population after two years.

Objective- Application.

PROCESS INVOLVED IN THE SOLUTION :

1. Calculates increase in population in first year.

2. Calculates increase in population in second year on the population after first year.

3. Calculate population after second year.

Or

Determines directly the population after 2 years by substituting in the formula of compound interest.

POSSIBLE ERRORS :

1. Calculates increase in population for two years on the initial population.

2. One is unable to make any distinction between increase in population and increased population.

3. Calculates wrongly the increase in population as

$$\frac{136401 \times 100}{110} = \frac{13640100}{11}$$

4. Calculation mistake.

STATISTICAL DATA

Category	Error No. 1	2	3	4	Not Attempted.	Attempted.	Irrelevant.
I	5	-	-	3	-	51	-
II	18	2	-	17	4	72	2
III	25	9	1	19	9	93	2
Failures	35	3	5	15	8	65	6
Total	84	14	6	54	19	281	10
Percentage	29.9	5	2.1	19.2	6.3	93.7	3.6

Data in terms of percentage :

Category	Error No. 1	2	3	4
I	12	0	0	6
II	25	2.8	0	23.6
III	26.6	9.7	1	20.4
Failures	53.8	4.6	7.7	23.1

INTERPRETATION OF THE DATA :

It is obvious that errors No. 2 and 3 are not the common errors. Only common errors are first and fourth.

Mostly candidates have calculated increase in population for two years on the initial population and calculation mistake is a general error.

Question No. 5

Unit- Average.

Question- The average of five numbers is 15 and that of last three numbers is 17. Find the average of first two numbers.

Objective- Application.

Processes involved in the solution :

1. Recalls the formula of sum of numbers = Average x No. of numbers.

2. Calculates sum of five numbers.

3. Calculates sum of last three numbers.

4. Calculates sum of first two numbers as sum of five numbers - sum of last three numbers.

5. Finds average of first two = $\frac{\text{sum of first two numbers}}{2}$

Possible errors :

1. One takes average of numbers i.e. sum of numbers i.e. does not make any distinction between average of numbers and sum of numbers.
2. One does mistake in computation.
3. For finding the sum of first two numbers, one adds the sum of five numbers and the sum of last three numbers.
4. One finds average of first two as average of five as minus average of last three.
5. One calculates average of first two = $\frac{15+17}{2}$ = 16.
6. One calculates average of two = $\frac{17-15}{2}$ = 1.
7. One finds average of first two as difference of two sums i.e. sum of five numbers - sum of last three = 75 - 51 = 24.

STATISTICAL DATA (In figures)

Category	Error No.						Wrong	Not attempted.	Irrelevant.
	1	2	3	4	5	6			
I	4	1	-	3	-	-	-	1	-
II	19	-	4	1	-	-	18	5	-
III	10	4	4	-	2	2	27	15	8
Failure	9	8	3	1	6	1	15	16	15
Total	42	13	11	5	8	3	60	37	28
Percentage	16	5	4.1	1.9	3	1.1	22.8	12.3	10.6

Data in terms of percentage :

Category	Error No. 1	2	3	4	5	6	7	Attempted.
I	8	2	0	6	-	-	-	50
II	26.8	-	5.6	1.4	-	-	25.4	71
III	11.5	4.6	4.6	-	2.3	2.3	31	87
Failures	16.4	14.5	5.7	1.9	10.9	1.9	27.3	55
								263

INTERPRETATION OF THE DATA :

From these data we observe that errors no. 1 and 7 are common errors. None of the other errors is a common error. Since the problem of average does not involve much calculations, hence these candidates committed computational mistake very rarely.

The candidates generally got confused between the average of numbers and the sum of the numbers which is error No. 1 and wrote the answer as

Average of five numbers = 15 x 5 = 75

Average of last three numbers = 17 x 3 = 51.

Average of first two numbers = Average of five numbers - $\frac{\text{Average of last three numbers}}{2}$

$= \frac{75-51}{2} = \frac{24}{2} = 12$ Ans.

There were so many candidates who, though, did not have any confusion between average of numbers and sum of numbers, but still obtained the solution with the error No. 7 e.g.

Sum of 5 numbers = 15 x 5 = 75.

Sum of last 3 numbers = 17 x 3 = 51.

Average of first two numbers = 75 - 51 = 24.

Thus the above described two errors are they only common errors.

Question No. 5

Unit- Time and distance. (Relative speed)

Question- Mohan and Sohan started from Ajmer and Vijainagar respectively at 10 a.m. to see each other. Mohan and Sohan travel at speeds of 5 km. and 7 km per hour respectively. Find at what time will they meet each other and how much distance each would have travelled by then, if the distance between the two places is 60 km.

Objective- Understanding.

Processes involved in the solution :

1. Determine relative speed of Mohan and Sohan as = 12 km / hr.

2. Find: time = $\frac{60}{12}$ hrs. = 5 hrs.

3. Find: distance travelled by Mohan = 5x5 = 25 kms.

4. Finds distance travelled by Sohan = 7x5 = 35kms.

5. Determine the time of meeting =(10+5)hrs.=3 p.m.

Possible errors :

1. Error in writing unit of speed (one may write the unit of speed here as km only instead of km / hr.)

2. Omission of units.

3. Calculate relative speed as 7-5 = 2 km/hr.

4. One does a mistake in fixing the time e.g. One may write the time = (10 + 5)hr = Any time other than 3.00 P.M.

5. One may make an error in recalling the formula relating to distance, time and speed - In place of D=V x t. One may use D x t = V or D=V÷t etc.

6. One may calculate different timings of meeting for Mohan and Sohan e.g. time for Mohan = $\frac{60}{5}$ & 12 hours and for Sohan $\frac{60}{7}$ hrs. , etc

STATISTICAL DATA (IN FIGURES)

Category	Error No.						Not Attempted	Attempted	Irrelevant
	1	2	3	4	5	6			
I	2	2	-	3	3	1	1	50	-
II	20	3	4	4	-	6	10	66	6
III	15	9	8	4	2	9	24	78	15
Failure	3	1	3	4	-	9	28	43	23
Total	40	15	15	15	5	25	63	237	40
Percentage	16.9	6.3	6.3	6.3	2.1	10.5	21	79	16.9

Data in percentage :

Category	Error No.						Attempted
	1	2	3	4	5	6	
I	4	4	-	6	6	2	50
II	30.3	4.5	6.1	6.1	-	9.1	66
III	19.2	11.5	10.3	5.1	2.6	11.5	78
Failure	7	2.3	7	9.3	-	21	43

INTERPRETATION OF THE DATA :

These data show that errors No. 1 and 6 are common errors. Very few candidates omitted the unit of speed. Certainly there were many who wrote the unit of speed km. in place of km/hr. There were some who could not calculate the time of their meetingand if calculated, it was other than

3 p.m. some wrote it as 5 P.M. and a few wrote it as 2. p.m. while there were a few who simply wrote the time as 10 + 5 = 15 hrs. etc. Usually candidates recalled the formula correctly. A few candidates obtained the relative speed as 7-5 = 2 km/hr. There were many candidates who obtained different times of their travel before they met e.g. time for Noha = $\frac{60}{5}$ = 12 hrs. and for Sohan $\frac{60}{7}$ hrs. etc.

Question No. 7

Unit- Equations (Simultaneous)

Objective- Application.

Question- Ten years ago the age of the father was five times the age of his son and twenty years hence the age of the father will be twice the age of his son. Find the age of the father.

Processes involved in the solution :

1. Supposes the present age of the son as x yrs. and consequently finds the age of the father 10 years before or vice- versa.

2. Calculates the age of the father and son, 20 years hence.

3. Forming equations.

4. Solving equations and getting present age of the father 60 years and that of his son equal to 20 years.

Possible Errors :

1. In place of multiplying the age of the son, one may multiply the age of the father in forming equation.
2. One may make a mistake in transposing terms in solving the equation.
3. One calculates the age of the son and puts it as the answer.
4. One does not consider the age before 10 years and consequently does not form the corresponding equation.

STATISTICAL DATA

Category	Error No.				Not Attempted.	Attempted.	Irrelevent.
	1	2	3	4			
I	-	-	-	3	35	16	2
II	2	-	-	3	56	20	10
III	1	1	-	10	59	43	16
Failure	-	-	-	7	44	27	19
Total	3	1	-	23	194	106	47
Percentage	2.8	9	-	21.7	64.7	35.3	44.3

Data in percentage :

Category	Error No.				Attempted.
	1	2	3	4	
I	-	-	-	10.75	16
II	10	-	-	15	20
III	2.3	2.3	-	25.26	43
Failure	-	-	-	25.0	27

INTERPRETATION OF THE DATA

Error No. 4 is the only common error. None of the other errors is a common error. In this problem more than 44% candidates did irrelevent work (not connected with the problem). Most of the candidates could not form the necessary equations.

Question No. 7(i) (Alternative)

Unit- Set Theory

Objective- Application

Question- If $A = \{1,2,3,4\}$; $B = \{2,3,5,8\}$ and $C = \{3,4,5,6\}$, then prove that $A \cup (B \cup C) = (A \cup B) \cup C$.

PROCESSES INVOLVED IN THE SOLUTION:

1. Finds $B \cup C$ by taking all the elements of A and B and writes $B \cup C = \{2,3,4,5,6,8\}$.

2. Consequently finds A ∪ (B∪C) = {1,2,3,4,5,6,8}

3. Finds A ∪ B = {1,2,3,4,6,8}

4. Then finds (A ∪B) ∪ C = {1,2,3,4,5,6,8}

5. Then verifies that all the elements are common in the two sets A ∪ (B∪ C) and (A ∪ B) ∪ C, and hence concludes that (A ∪ B) ∪ C = A ∪ (B ∪ C).

Possible Errors :

1. One may not have any concept of the symbol of union and thus calculate B ∪ C and A ∪ B incorrectly.

2. One draws only the 8 Venn. diagra for A ∪ (B ∪C) and (A ∪ B) ∪C and ends the solution there itself without further arguments.

3. One omits or writes wrong symbol for the symbol of theset i.e. one may use ( ) or [ ] in place of { } to represent a set.

4. One may not put comma betweenconsecutive elemtns.

5. One may write A ∪ (B∪ C) = (A ∪ B) ∪ C = {1,2,3,4,5,6,7,8} i.e. in a hurry includes the elements 7.

STATISTICAL DATA

Category	Error No.					Not attempted.	Attempted.	Irrelevant
	1	2	3	4	5			
I	9	-	5	1	-	22	29	4
II	11	2	10	-	-	37	39	9
III	9	1	8	1	-	63	39	8
Failure	14	-	1	-	-	44	27	8
Total	43	3	24	2	-	166	134	29
Percentage	32.1	2.2	17.9	1.5	-	NR 55.3	44.7	21.6

INTERPRETATION OF THE DATA

Errors Nos. 1 and 3 are common errors. Most of the candidates did not have the concept of the symbol of union, hence could not find A ∪ B and B ∪ C and consequently A ∪ (B ∪ C) and (A ∪ B) ∪ C. Many of these candidates who attempted this part (about 16%) did not know the symbol of representing the set either they did not put any symbol or put a wrong symbol like ( ) or [ ] in place of { }

Question No. 7(ii)(Alternative)

Unit- Sets (Venn diagram)..

Objective- Understanding.

Question- Represent $A \cap B$ by Venn diagram.

Processes involved in the solution :

1. Draws Venn diagram of $A \cap B$ when A and B are disjoint.

2. Draws Venn diagram of $A \cap B$ when one of these sets is a subset of the other.

3. Draws Venn diagram of $A \cap B$ when $A \cap B \neq \phi$ and none is contained in the other.

Possible errors :

1. One does not draw all the three diagrams.

2. One draws Venn diagram for $A \cup B$ in place of $A \cap B$.

3. Draws a diagram but does not shade it to show the correct portion of $A \cap B$.

STATISTICAL DATA

Category	Error No.			Not attempted.	Attempted.	Irrelevant.
	1	2	3			
I	26	-	1	24	27	1
II	23	1	-	42	34	7
III	25	-	-	64	38	5
Failure	16	-	-	48	23	6
Total	90	1	1	178	122	19

Data in terms of percentage :

Category	Error No. 1	2	3	Attempted.
I	96.3	-	3.7	27
II	67.6	2.9	-	34
III	65.0	-	-	30
Failure	69.6	-	-	23

INTERPRETATION OF THE DATA

None of the candidates drew all the three required diagrams. Almost none confused union with intersection and almost all have shaded the intersection part.

Question No. 8

Unit- Circle (Around circumference)

Objective- Understanding.

Question- The circumference of the top of a circular table is 198 cm. Find its diameter.

Processes involved in the solution :

1. Recalls the formula $C = \pi \times d$.
2. Substitutes the values of $C = 198 = \pi \times d$.
3. Evaluates $d = \frac{198}{\pi}$ cms = 63 cm.s after substituting $= \frac{22}{7}$

Possible Errors :

1. Uses $C = \pi r^2$ instead of $C = 2\pi r$ or $C = \pi d$.
2. Calculates r and does not convert it into diameter.
3. One does not write unit.
4. One uses diameter $= \frac{C}{2\pi}$ or $d = \frac{2\pi}{C}$ or $d = \pi C$.
5. Computational Error.

QUANTITATIVE DATA :

Category	Error No. 1	2	3	4	5	Not attempted.	Attempted.	Irrelevant
I	1	2	-	1	-	2	49	-
II	2	1	2	9	3	7	69	6
III	4	-	2	13	2	21	81	14
Failure	2	-	1	19	3	19	52	25
Total	9	3	5	41	8	49	251	45
Percentage	3.6	1.2	2	16.3	3.2	16.3	83.7	17.9

Data in terms of percentage :

Category	Error No. 1	2	3	4	5	Not attempted.
I	2	4.1	-	2	-	49
II	2.9	1.4	2.9	13	4.3	69
III	4.9	-	2.5	16	2.5	81
Failure	3.8	-	1.9	36.5	5.7	52

INTERPRETATION OF THE DATA

The common error in this problem is the inability of recall of the correct formula. Many of these used $d = \frac{C}{2\pi}$, a very few used $d = \frac{2\pi}{C}$ or $\frac{\pi}{C}$ etc. There were only 3.6% candidates who used $C = \pi r^2$ (an incorrect formula). There were about two percent candidates who did not use unit of the diameter & circumference. A very few candidates did computational error.

Question No. 9

Unit- Cylinder.

Objective- Knowledge.

Question- The height of a cylinder is 45 cm.s and its radius is 14 cm. Find the curved and total surface of the cylinder.

Processes involved in the solution :

1. Using the correct formula for the curved surface i.e. $2\pi rh$.
2. One calculates the curved surface by substituting the values of the height and radius of the cylinder in the given formula and arrives at the correct result which is equal to 3960 Sq. c.m.
3. One uses the correct formula for the area of the plane surface (circular surface) which is equal to πr^2

4. Substitutes the value of the radius and gets $2\pi (14)^2$

5. Calculates the total surface i.e. 5192 sq.cm.

6. Recalls the formula for the whole surface and substitutes the correct terms and simplifies.

Possible errors :

1. One applies a wrong formula $\pi r^2 h$ instead of $2\pi rh$ for the curved surface.

2. Similarly one applies wrong formula for the area of the circular plane faces e.g. $2\pi r$ in place of $\frac{1}{2}\pi r^2$ or applies any other wrong formula.

3. One may take area of one surface only instead of both with the curved surface to obtain the whole surface.

4. One may write the answer at the initial stage only where he arrives at the area of the curved surface i.e. 3960 sq.cm.

5. Computation- error.

6. One may take curved surface as the total surface.

7. One may omit to write the units of the area.

8. One may put wrong units.

STATISTICAL DATA :

Category	Error No.								Not attempted.	Attempted.	Irrelevant
	1	2	3	4	5	6	7	8			
I	-	2	-	-	6	-	4	1	25	26	-
II	9	6	2	1	9	3	7	5	43	33	1
III	5	9	3	1	15	3	11	2	57	62 38	2
Failure	9	2	-	-	3	1	5	3	47	24	7
Total	23	19	5	2	33	7	27	11	182	118	10
Percentage	19.5	16.1	4.2	1.6	28	5.9	22.9	9.3	60.7	39.3	8.5

Data in terms of percentage :

Category	Error No.								Attempted.
	1	2	3	4	5	6	7	8	
I	0	7.7	0	0	23.1	0	15.4	3.9	26
II	27.3	18.2	6.1	3	27.3	9.1	21.2	15.2	33
III	14.3	25.7	8.6	2.9	42.9	8.6	31.4	5.7	35
Failure	37.5	8.3	-	-	12.5	4.2	20.8	12.5	24

INTERPRETATION OF THE DATA

1. Theee data show that Errors No. 1,2,5 and 7 are the common errors.

2. About 9 percent candidates were ignorant of the units and they put wrong units for the area e.g. they wrote Cm in stead of sq.cm. for the unit of area.

3. About 1/5th of the whole lot (who attempted) got confused surface area with the volume of the cylinder and about 1/6th of the whole lot got confused area of the plane surface with its circumference.

4. About 1/4th of the whole lot (who attempted) did not write the units of the area.

Most of the error committors were from second divisioners, third divisioners and failures.

Question No. 9(Alternative)

Unit- Area of rectangular paths.

Objective- Knowledge.

Question- A rectangular garden is 180 M long and 120 M wide There are two paths each 5 m wide in the middle of the garden and parallel to its length and breadth. Find the total area of the paths.

Processes involved in the solution :

1. Draws correct diagram of the two paths.

2. Finds the area of each path by multiplying the length with its width 180 x 5 sq.m., 120x5 sq.m.

3. Finds the sum of these two areas = (900 +600) sq.m.

4. Finds the area of the common path (i.e. square) = 5 x 5 = 25 sq.m.

5. Subtracts the common area from the sum of the areas of the two paths and gets = 1500-25=1475 sq.m.

Possible Errors :

1. One does not draw the path in the central portion of the field but draws it on the boundary of the field.

2. One does not take account of the area of the common path in finding the total area of the paths.

3. One does computational error.

4. One draws a wrong diagram other than described in error no. 1.

5. Omission of Units.

STATISTICAL DATA :

Category	Error No.					Not Attempted.	Attempted.	Incorrect.
	1	2	3	4	5			
I	-	-	2	6	-	27	24	-
II	5	1	-	4	6	35	41	6
III	4	3	7	-	3	43	59	23
Failure	3	1	2	2	8	32	39	15
Total	12	5	11	6	17	137	153	44
Percentage	7.4	3.1	6.7	3.7	10.4	45.7	54.3	27

Data in terms of percentage :

Category	Error No.					Attempted.
	1	2	3	4	5	
I	-	-	8.3	-	-	24
II	12.2	2.4	-	9.8	14.6	41
III	6.8	5.1	11.9	-	5.1	59
Failure	7.7	2.6	5.1	5.1	20.5	39

INTERPRETATION OF THE DATA

The following are the observations from the data :

1. Omission of units is the only common error in this problem.

2. The misunderstanding of the paths at the boundary in place of centre remained a common error for second divisioners but did not remain a common error for others.

3. First and third divisioners committed error in general in the computational work.

4. About 27% of the candidates including second, third divisioners and failures did totally an irrelevant work such as found the area of the field in place of paths, or did not complete the problem, took only 1 step etc.

Question No. 10

Unit- Trigonometrical ratios and use of standard identities.

Objective- Understanding.

Question Prove that $\cot^2\theta(\sec^2\theta - 1) = 1$

Processes involved in the solution :

1. Writes the value of $\sec^2\theta - = 1$ by using the formula $\sec^2\theta = 1 + \tan^2\theta$

2. Cancels $\cot^2\theta$ with $\tan^2\theta$ in theproduct to give the result 1.

Or

Alternatively.

1. Converts cot θ andsecθ into sinθ and cosθ.

2. Uses $1 - \cos^2\theta = \sin^2\theta$.

3. Simplifies and gets 1.

Possible Errors :

1. One does not apply the formula $\sec^2\theta = 1 + \tan^2\theta$ correctly or $1 - \cos^2\theta = \sin^2\theta$.

2. One does not recall that $\cot\theta = \frac{1}{\tan\theta}$ or $\cot\theta = \frac{\cos\theta}{\sin\theta}$

3. Computation-error.

4. Mistakes in opening the brackets.

STATISTICAL DATA

Category	Error No.				Not attempted.	Attempted.	Irrelevant.
	1	2	3	4			
I	7	3	5	7	22	29	1
II	9	4	4	5	49	27	11
III	12	11	6	4	82	20	6
Failure	5	4	2	-	58	13	6
Total	33	22	17	16	211	89	24
Percentage	37.1	24.7	19.1	18	70.3	29.7	26.9

Data in terms of percentage :

Category	Error No.				Attempted.
	1	2	3	4	
I	24.1	10.3	17.2	24.1	29
II	33.3	14.8	14.8	18.5	27
III	60	55	30	20	20
Failure	38.5	30.3	15.4	-	13

INTERPRETATION OF THE DATA

From the data it is clear that all these errors are the common errors.

It shows that a large number of candidates did not prepare this chapter of trigonometry.

Question No. 18(Alternative part)

Unit- Solution of right angled triangle(Trigonometry)

Objective- Understanding

Question- In the $\triangle ABC$, $C = 90^0$, $a = 6$, $b = 6\sqrt{3}$, then find the remaining elements of the triangle.

Processes involved in the solution :

1. Using Pythagoras theorem, calculate the value of the third side $C = 12$.

2. Applies the tratio ton $A = \frac{BC}{AC}$ for finding the value of the angle A andgets $A = 30^0$.

3. Calculates the value of the third angle by using $A+B+C = 180^0$ i.e. $A+B=90^0$ andgets $B = 60^0$.

Possible Errors :

1. One does not remember the relation between the three sides of a right angled triangle i.e. pythagoras theorem.

2. One does not remember the correct value of the t-ratio - which is used to find the value of one angle.

3. Computational error.

4. One determines one angle only or one side only.

5. One is unable to recognise the remaining elements.

6. One does not know the sides a, b, c.

STATISTICAL DATA

Category	Error No.						Not attem-pted.	Attem-pted.	Irre-levement.
	1	2	3	4	5	6			
I	-	1	1	1	1	4	39	12	2
II	3	2	3	2	3	2	60	16	8
III	20	8	6	7	12	13	65	37	14
Failure	13	3	1	1	4	5	52	19	8
Total	36	14	11	11	20	24	216	84	32
Percentage	42.9	16.7	13.1	13.1	23.8	20.6	72	28	38.1

DATA IN TERMS OF PERCENTAGE

Category	Error No.						Attem-pted.
	1	2	3	4	5	6	
I	-	8.3	8.3	8.3	8.3	33.3	12
II	18.8	12.5	18.8	12.5	18.8	12.5	16
III	54.1	21.6	16.2	10.9	32.4	35.1	37
Failure	68.4	15.8	5.3	5.3	21.1	26.3	19

INTERPRETATION OF THE DATA

1. These data show that all the above mentioned possible errors are common errors.

2. First divisioners commit these errors very rarely.

3. About 38 percent of the candidates have done quite an irrelevent work e.g. one did not draw a

right angled triangle with right angle at C, then used some t-ratio very incorrectly (i.e. without knowing its meaning) and could not find any thing.

4. About 20 percent candidates were quite unfamiliar with the meaning of sides a,b,c e.g. one took a as AB, b as BC and c AS CA etc.

Question No. 11

Unit- Areas of rectangular fields.

Objective- Application

Question- The perimeter of a square field is 200 m. Find the length of a rectangular field whose breadth is 25 m and equal in area to that of the square.

Processes involved in the solution :

1. Writes the formula

Perimeter of a square = 4 times of the side of the square and finds the value of the side = $\frac{200}{4}$ =50m.

2. Finds the area of the square by squaring the value of its side = 50^2 = 2500 sq.m.

3. Writes the formula for the area of a rectangle: area of a rectangle = length x breadth, then takes breadth = 25 m. and Area = 2500 sq.m. and gets 2500 = 25 x l . (l = length).

4. Calculates the value of the length i.e. 1 = 100 m.

Possible Errors :

1. One does not distinguish perimeter from the area.

2. One uses the incorrect formula, length = area x breadth due to wrong conception of the formula.

3. One does not discriminate square from rectangle.

4. One does not distinguish perimeter from the side of the x square.

STATISTICAL DATA :

Category	Error No. 1	2	3	4	Attempted.	Irrelevant.
I	2	-	1	1	40	6
II	16	-	-	10	67	7
III	30	-	2	6	73	23
Failure	23	1	1	18	55	24
Total	71	1	4	35	243	60
Percentage	29.2	.4	1.6	14.4	81	24.7

Data in terms of percentage :

Category	Error No. 1	2	3	4	Attempted
I	4.2	-	2.1	2.1	48
II	23.9	-	-	14.9	67
III	41.1	-	2.7	8.2	73
Failure	41.8	1.8	1.8	32.7	55

INTERPRETATION OF THE DATA

1. Data make it clear that error No. 1 and 4 are only the common errors.

2. Only one candidate used an incorrect formula like - length = Area x breadth.

3. Similarly there were only four candidates who did not discriminate a square from a rectangle.

4. Quite a large number of candidates did not know pythagoras theorem and the number of these candidates was also quite significant who did not distinguish the sides a, b and c in the triangle ABC.

Question No. 12

Unit- Pythagoras Theorem.

Objective- Knowledge.

Question- In a right angled triangle, the hypotenuse is 10 cm and one side is 6 cm. Find the length of the remaining side.

Processes involved in the solution :

1. Writes the formula
(Hypotenuse)^2= (One side)^2+ (other side)^2

2. Substitutes the values of the hypotenuse and one side and gets $10^2 = 6^2 +$ (other side)^2

3. Calculates the value of the remaining side = 8 cm.

Possible errors :

1. One does not use the sign of equality.
2. One takes square of the side like $AB^2 = \sqrt{64} =$ 8 cm.
3. Writes area = 10 x 6.
4. Applies wrong formula.
5. Computational Error.

STATISTICAL DATA

Category	Error No. 1	2	3	4	5	Attempted.	Irrelevant.
I	-	-	-	1	-	49	-
II	-	6	-	5	2	66	2
III	2	12	1	29	4	95	13
Failure	1	-	6	22	1	52	11
Total	3	10	7	61	7	253	26
Percentage	1.2	7.1	2.8	24.1	2.8	84.3	10.3

Data in terms of percentage :

Category	Error No. 1	2	3	4	5	Attempted
I	-	-	-	2	-	49
II	-	9.1	-	13.6	3	66
III	2.3	14	1.2	33.7	4.6	95
Failure	2	-	11.5	42.3	2	52

INTERPRETATION OF THE DATA

1. First divisioners did not commit any of these errors except one candidate who committed the fourth error. Thus none of these errors is a common error for first divisioners.

2. Second divisioners also committed these errors rarely. It looks that error No. 2 and 4 are the common errors for second divisioners.

3. The fourth error is a common error.

4. Many of the candidates could not draw even the rough sketch of the given right angled triangle. There were some candidates who even did not know the meaning of the sides, hypotenuse and one side etc. and took 10 as a side other than hypotenuse. Some drew the figure correctly but then could not apply pythagoras theorem rightly and wrote

$$10^2 + 6^2 = (\text{ other side })^2$$

etc.

It was a common fact that many wrote solution as
$(AB)^2+(AC)^2=(BC)^2$, from the figure with A as right angle & then took the steps,

$$(AB)^2 + 6^2 = 10^2$$

or $(AB)^2 = 10^2 - 6^2 = 100-36 = 64 = 64 = 8$ Ans.

Question No. 13

Unit- Volume of a cuboid.

-1- 1-

Objective : Application.

Question: A cistern is 4 m long, 2 m 50 cm wide and 1 m 50 cm deep. If one litre of water occupies 1000 cm^3 of space, find how many litres of water can be contained in the cistern.

Processes involved in the solution :

1. Finds the volume of the cistern = 4 x 2,5 x 1,5 = ~~15 m³~~ 15 m^3

2. Converts the volume of the cistern into cubic centimetres by multiplying it by 100^3 = 1000000 and gets the volume = 15000000 cm^3.

3. Finds the volume of water in litres by dividing with 1000 and gets the required result = 15000 litres.

Possible Errors :

1. One may write area of the cistern = lxbxh.
2. One may not have any knowledge regarding conversions from m^3 into cm^3.
3. One can not correlate the volume of the cistern with volume of one litre of water in finding the volume of contained water in litres.
4. One shows quite ignorance about litres etc.
5. One may apply the formula volume of cistern = 2(lb+ bh+ hl).

6. Computational error.

7. One may apply volume or Area = 2(l + b) h for working of the problem.

STATISTICAL DATA

Category	Error No.							Attempted	Irrelevent.
	1	2	3	4	5	6	7		
I	1	15	12	6	3	6	1	48	1
II	8	35	12	14	9	8	11	69	4
III	12	25	23	27	13	9	14	86	15
Failure	11	21	19	13	211	2	87	248	13
Total	32	96	66	54	36	25	33	251	33
Percentage	12.7	38.2	26.3	21.5	14.3	10	13.1	83.7	13.1

Data in terms of percentage :

Category	Error No.							Attempted.
	1	2	3	4	5	6	7	
I	2.1	31.3	25	12.5	6.3	12.5	2.1	48
II	11.6	50.7	17.4	20.3	13	11.6	15.9	69
III	14	29.1	26.8	24.4	15.1	10.5	66.3	86
Failure	22.9	43.8	35.6	27.1	22.9	4.2	14.6	48

INTERPRETATION OF THE DATA

1. Almost all the above listed errors are observed as common errors. Students frequently commit all these types of errors. Those who committed mistakes comprised of all categories of candidates.

It seems, this unit must have been taught at the end of the session and no thorough preparation of this unit was made by the candidates.

Question No. 14

Unit- Graph

Objective: Skill

Question The temperature of a patient on a certain day is given by the following table :

Time :	7 a.m.	9 a.m.	11 a.m.	1 p.m.	3 p.m.	5 p.m.
Temperature	37°C	37.2°C	38°C	39.1°C	38.5°C	37.6°C.

Processes involved in the solution :

1. Chooses appropriate scale for each of time and temperature.

2. Plots the points and draws the graph by joining the plotted points by straight lines.

3. Interprets the graph for finding the temperature at 8 a.m. and 4 p.m. and obtains temperature at 8 a.m. = 37.1°C and at 4 p.m. = ≅ 38.05°C.

Possible Errors :

1. One cannot choose appropriate scale.
2. One cannot plot points correctly.
3. One has no idea about the scale andplotting.
4. One cannot interpret the result i.e. makes mistake in interpreting the result.

5. One joins the plotted points inaccurately.

STATISTICAL DATA

Category	Error No.					Attempted	Irrelevant.
	1	2	3	4	5		
I	9	11	7	21	1	50	-
II	25	35	26	45	3	71	2
III	37	58	59	74	3	97	-
Failure	32	36	40	41	1	65	2
Total	103	140	132	181	8	283	4
Percentage	36.4	49.5	46.6	63.9	2.8	94.3	1.4

Data in terms of percentage :

Category	Error No.					Attempted
	1	2	3	4	5	
I	18	22	14	42	2	50
II	35.2	49.3	24 36.6	63.4	4.2	71
III	38.1	59.8	60.8	86.3	3.1	97
Failure	49.1	55.4	61.5	63.1	1.5	65

INTERPRETATION OF THE DATA

From the data it is clear that first, second, third and fourth errors are the common errors. A few candidates did not join the plotted points by straight lines but joined them by curved lines.

All these errors are due to the fact that students are not given enough practice of plotting the points. Most of the candidates leave this topic in choice it is why these general errors, which are due to ignorance of the subject, are taking their position among the common errors.

A consolidated list of Kernel and consequential errors occuring in section B is given in Appendix B.

CHAPTER - FIFTH

15. RELATIONSHIP BETWEEN DIFFERENT UNITS, CONCLUSIONS AND SUGGESTIONS

In this section we shall try to see inter-relationship between the various (Chapters) units of the syllabus.

1. SQUARE ROOT AND CUBE ROOT

Its basic concept is derived from the index laws. When one looks into the solution of general equation

$$x^2 = a$$

in one unknown x, he has to take care of the numbers of the form $a^{1/2}$, whose square is considered to be a.

Similarly , numbers of the form $a^{1/3}$ are solutions of the equation of the form

$$x^3 = a$$

and these are those numbers whose cube is a .

Square root and cube root both are very important concepts. Both these topics have wide application in various

other Areas of theSyllabus - such as :

1. Factorisation - (Algebra)
2. Compound Interest problems (Arithmetic)
3. Ratio and proportion (Arithmetic)
4. Pythagoras theorem problems (Geometry)
5. Areas of squares and circles (Geometry)
6. Volumesof Cylinder, sphere, etc.(Geometry)
7. Relation among t-ratios (Trigonometry)
8. Values of standard angles (Trigonometry).

etc.

(i) STUDY OF SQUARE ROOT AND CUBE ROOT IN FACTORIZATION :

In factorization, we come accross various expressions which involve square root of a product of two quantities, e.g. in part B of this paper if we go through the question on factorization we have in Q.7 (a) terms like $25x^4$, $4y^4$, in Q.1(b) terms like $49y^2$ etc. which are required to be written in the form $(5x^2)^2$, $(2y)^2$ and $(7y)^2$ respectively exi in the first step of factorization. In these cases we need square root of these terms i.e. we need to find out square root of 25 as 5, square root of x^4 as x^2, square root of $49y^2$ as 7y etc. Similarly in some other questions on factorization we are expected to know the knowledge of cube roots etc. e.g. in the factorization of

$27x^3 - 64y^6$, we are required to know the cube roots of both $27x^3$ and $64y^6$ etc.

If a candidate does not have the concept of square root and cube root or has wrong concepts of these units, he will not be able to do factorization correctly at such steps, i.e. he will not succeed to convert $25x^4$ into $(5x^2)^2$ etc. and consequently will not be able to factorize such expressions. From the collected statistics of 300 answerscripts of the candidates of all categories of the Exam. 1972, we observe that about 19 per ent candidates of could not factorize Q 1(a) on account of the wrong concept of square root : These 19 percent candidates included 6 percent first divisioners, 19 percent second divisioners, 10 percent third divisioners and 35 percent failures. Had this concept of square root of a product of two terms been clear, it would have certainly enabled them to factorize it correctly and consequently would have improved their result and also the pass p rcentage in the subject at the Board. Similarly in Q 1(b) this lack of knowledge of square root has led about 21 percent of the candidates to failure in factorization including about 14 percent first divisioners, 5 percent second divisioners, 23 percent third divisioners and 42 percent failures.

(ii) SQUARE ROOT OR CUBE ROOT IN COMPOUND INTEREST PROBLEM:

If there is a problem in which it is said that a sum P becomes the amount A in two or three years, find the rate of commound interest, one will be required to use the formula

$$A = P(1+\frac{i}{100})^2 \quad \text{or} \quad A = P\,(1+\frac{i}{100})^3 \text{ etc.}$$

and then to find i it is necessary to find the square root or cube root of A/P. It shows that the knowledge of cube root or square root is needed in solving various problems of compound interest, annuities, etc.

(iii) IN RATIO AND PROPORTION :

If there are problems of the type. ' Find the mean propo tional of a and b ', then we have to find the mean proportional = $\sqrt{ab}$, i.e. here also be require the concept of square root.

(iv) IN PYTHAGURAS THEOREM PROBLEMS :

In all the numerical problems on pythagoras theorem, one needs the knowledge of square root e.g. in Q. 12 of Part II of this paper, we are given hypotenuse = 10 cm and one side = 6 cm. and we are asked to find the value of the third side. It's solution is

$$10^2 = 6^2 + (\text{other side})^2$$

$$(\text{other side})^2 = 10^2 - 6^2 = 100 - 36$$
$$= 64.$$
$$\therefore \text{other side} = \sqrt{64} = 8 \text{ cm.}$$

Thus here also we require the concept of square root. The collected statistics show that due to lack of knowledge of this concept about 3 percent candidates could not find the correct answer of this problem.

Another one the situation in Q. 10 (alternative part).

(v) IN AREAS OF SQUARES AND CIRCLES :

In both the cases if area of square or circle is given and it's side or radius is required, we always need to use the concept of square root.

(vi) IN VOLUMES OF SPHERE OR CYLINDER :

In the problem on these units if the volume is given and the radius or base radius is required, we have need to use cube root or square root etc.

(vii) IN TRIGONOMETRY (IN RELATION AMONG T- RATIOS)

In the problems where value of a particular t-ratio is given and the values of other t-ratios are required, we need to use the concept of square root e.g. in Q 15

(Part A).

(viii) IN TRIGONOMETRY - ∈

(In height and distances problems) etc.

II. PERCENTAGE

Percentage is another important concept. It also has applications in various other units of the syllabus such as :

1. Simple interest,
2. Compound interest,
3. Profit and loss,
4. Partnership.

etc.

In simple & interest the rate of interest is always given in terms of percentage e.g. at the rate of 6 percent per annum. etc. In compound interest too the rate of interest is given in percentage. In profit, and loss, the profit and loss are also given in percentage. In partnership, it is sometimes said that of the total sum the shares of the partners are x percent, y percent, z percent, respectively etc. Thus it is basic to learn percentage before we proceed to learn these other units. Due to lack of knowledge of percentage about 10.2% candidates committed error of using unitary law incorrectly.

III. SIMPLE INTEREST :

The concept of simple interest is basic for compound interest problems and increase in population problems e.g. In Q. No. 3 of Part A of this paper, it is required to find out the compound interest on Rs. 1,000/- for four years at the rate of 10 percent annually and in the Q. No. 4 of Part B, the present population of a city is given and it is required to find out the population after two years when it increase at the rate of 10 percent annually.

It shows that one can only do these problems if one has the concept of simple interest.

Because of lack of theKnowledge of simple interest about 2 percent candidates could not attempt Q.No. 4 of Part B correctly.

IV. RATIO AND PROPORTION :

The concept of ratio and proportion is basis in the other units like division into proportional parts, partnership and trigonometry.

Q. Nos. 7 and 8 of Part A are based on ratio and proportion. Question Nos. 16 , 19 of Part A and Q. No. 12 of Part B are from trigonometry and partnerships etc. All these

questions require basic knowledge of ratio and proportion, without which none can be solved.

V. FACTORS :

Factors are basic in simple, simple simultaneous and quadratic equations which are indirectly or directly used in various problems of geometry and trigonometry (including mensuration). Since there was no problem on these units in this question paper, it could not be illustrated with the help of these data.

VI. LOGARITHMS :

It is used to find out values of various types of numerical expressions involving multiplication, division involution and evolution operations and is thus required whenever such expressions are involved in problems, may be from Algebra, Geometry or Trigonometry. Hence its knowledge is basic in all these fields. Since there was no problem on the application of this unit in this question paper, it could not be illustrated with data.

VII. AREA OF A RECTANGLE :

The concept of area of a rectangle is basic for the following units :

i) area of a parallelogram;

ii) area of a triangle;

iii) area of a trapezium;

iv) area of irregular fields ;

v) pythagoras theorem;

vi) area of four walls;

vii) surface area of cuboids;

viii) surface area of prisms ;

ix) problems of carpeting and flooring;

x) area of a circle; and

xi) Area of curved surface of a cylinder.

We know that :

i) the rectangles and parallelograms drawn on the same base or on equal bases and between the same parallels are always equal and thus derive that area of parallelogram = base length x perpendicular distance between two parallels including the base;

ii) a triangle and a rectangle or a parallelogram are situated on the same base and between the same parallels then area of that triangle is equal to half of thearea of that rectnangle;

iii) area of trapezium is equal to sum of the areas of two triangle obtained by drawing a diagonal;

iv) the area of the square drawn on the hypotenuse of a right angled triangle is equal to theoum of

the areas of the squares drawn on its other two sides (Pythagoras theorem);

v) all the walls of a room are rectangles and thus area of four walls is the sum of the areas of the four rectangles;

vi) the surface area of cuboids and prisms also depend on the areas of rectangles and triangles involved; similar is the situation in the problems of carpeting or flooring of a room ;

vii) area of a circle is derived from the area of triangles in limiting case ;

viii) surface area of a cylinder is exactly an area of a rectangle.

All the above mentioned facts show that the concept of the area of a rectangle is basic for all the above mentioned units which are in one or the other manner used in the problems of daily life.

In this question paper I the analysis of Q.No. 17 and 18 of part A and Q. Nos. 9, 10, 11, 12 illustrate p this point clearly.

VIII. <u>TRIGONOMETRICAL RATIOS</u> :

Every one who has read trigonometry knows that

trigonometrical ratios are basic in the complete theory of trigonometry and in the problems on the solution of triangles or we can say in the problems on height and distances.

For want of the knowledge of this topic, about 18.1% candidates made error in solving the right angled triangle of Q. No. 10 (alternative part).

2. EVALUATING AND SUGGESTION :

The present trend of setting Question Papers and evaluating answer books is worth praising. But it some times fail to achieve its objective. The setting of Part A of the question paper is not an easy job. It requires a lot of practice to set multiple choice questions. Stems (distractors) formed are sometimes useless, and non-functional. If a paper has too many questions of this nature, it certainly improves the result of the examination and from no corner any hue and cry is heard but the paper does not make a proper evaluation.

I, therefore, suggest that (i) in Part A, the number of multiple choice questions should be reduced from 18 to 10 or 12 and short- answer questions may be increased from 6 to 8 or 10; (ii) the setters may be asked to give the explanation for setting a question under a

particular objective ; (iii) the setter may also be asked to give the expectationof errors in forming the distractors with incorrect results.

All these measures will enable the Board to get good questions set in the question papers. For short answer questions of Part A, some space may be provided to write one or two steps to arrive at the answer.

In chapter V we have established interrelationship between different units. If the teachers take care of the fundamental mistakes committed in square roots, cube roots, recentages and axes which lead to consequential errors in other areas of [illegible] mathematics as exemplified in the chapter II and III and the Appendix A and B, it would definitely lead to improvement the class-room teaching and the examination results of the Board.

I suggest that all the common errors which are obtained in Chapter Third and Fourth alongwith this discussion on interrelationship of errors between different units of the syllabus should be brought into the handsof all the mathematics' teachers and mathematics' book-writers with a view to giving them advantage of the same while teaching and writing text books.

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APPENDIX - A

A LIST OF (KERNEL) AND CONSEQUENTIAL ERRORS :

OBSERVED IN DIFFERENT UNITS OF SECTION

The symbol KE denotes (Kernel) error and CE denotes consequential error CE 2.3 means consequential error No. 3 of Kernel error No. 2 of that unit.

UNIT - SQUARE ROOT

Q.No. 1 Part - A

KE.1 Error of not converting an intuger + a fraction in the form of $\frac{m}{n}$, where m and n are integers.

KE 2- Error of ignorance of the knowledge of finding square root of the numbers of the form $\frac{m}{n}$ as such uses $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{b}$ as in Q 1 part A of this paper.

CE 1.1 In question No. 1 part A one finds square root of $1\frac{9}{16}$ as square root of 1 x square root of $\frac{9}{16}$ and gets 1 x$\frac{3}{4}$ for $\sqrt{1\frac{9}{16}}$

CE 1.2 One finds $\sqrt{1\frac{9}{16}}$ = Square root of $(1 + \frac{9}{16})$

= Square root of 1 + square root of $\frac{9}{16}$

and gets it = $1 + \frac{3}{4} = 1\frac{3}{4}$ or $\frac{7}{4}$ etc.

Data showing the occurrance of these errors in this investigations are as :

CE 1.1	6%
CE 1.2	$19\frac{1}{3}$ %
KE 2	$6\frac{2}{3}$ %

UNIT PERCENTAGE

Q.No.2 Part A

KE 1. Error of ignorance of the knowledge of the meaning of percentage i.e. one does not know $47\% = \frac{47}{100}$ in Q. No. 2 of part A.

	IN CONSEQUENTIAL ERRORS	Percentage of occurrance.
CE 1.1	Taking $47\% = \frac{47}{1000} = 0.047$	$12\frac{1}{3}$
CE 1.2	Taking $47\% = \frac{47}{10} = 4.7$	10
CE 1.3	Taking 47% = 47	4

UNIT COMPOUND INTEREST

Q. No. 3 Part A

KE 1 Ignorance of the knowledge of the meaning of the terms AMOUNT, PRINCIPAL, INTEREST etc.

KE 2. Ignorance of the knowledge of the method of determining compound interest.

CE 1.1 One determines amount, when interest is asked as some candidates have done in Q. No. 3 part A

Weightage of this error in the data = 43%.

CE 1.2 For any given Principal one finds interest = Amount - Rs. 1/- . As in Q. No. 3 part A, candidates have ensured, compound interest on Rs. 1000/- for four years @ 10% = Rs. $\left\{1000\left(1+\frac{10}{100}\right)^4-1\right\}$

CE 2.1 Finds Interest = Principal - $\left(1+\frac{R}{100}\right)^n$

where R is the rate of interest and n is the number of (Intervals) years.

Weightage of this error in the data = $3\frac{2}{3}$ %.

UNIT PROFIT AND LOSS

Q.No. 4 Part A

KE 1 Error of ignorance of the meaning of the words cost price, selling price and profit or loss etc. in Hindi equivalent words क्रय मूल्य, विक्रय मूल्य और लाभ हानि आदि)

KE 2 Error of ignorance of the fact that profit or loss is calculated on cost price only.

KE 3 Error in using Unitary law incorrectly.

KE 4. Error due to Hastiness.

CE 1.1 When cost price is to be determined, one determines total profit or when total profit is asked, one determines selling price only. Some times selling price is given, profit percentage is given and cost price is wanted one uses these data as if he calculates profit on selling price or calculates cost price as

$$\text{Selling price} \times \frac{(100 + R)}{100}$$

where R is the rate of profit percentage.
This error can also be considered in consequence of KE 3. This error had weightage in the data = $33\frac{1}{3}\%$

CE 2.1 Uses profit = S.P. x $\frac{\text{rate percent of profit}}{100}$

or

Uses cost price = $\frac{\text{S.P.xrate percent of profit}}{100}$

It actually is in consequence of KE .1 & KE 2 both.
The weightage of this error in the data = $7\frac{1}{3}\%$

CE 3.1 ∓ C.E. 1.1

CE 4.1 Due to hastiness one may calculate the cost price by taking the data given for profit percentage as loss percentage and consequently arrives at

$$\text{C.P.} = \text{S.P.} \times \frac{100}{(100 - R)}$$

The weightage of the in error in the data

$= 2\frac{2}{3}\%$

UNIT RELATIVE SPEED

I.No. 5 Part A

KE 1 One confuses the notion of relative speed when they proceed in the same direction with the one when they proceed in opposite direction.

KE 2 Relative speed involves the operations of + or −, but due to ignorance of the subject matter i.e. of the knowledge of relative speed, he uses any other operation such as or x etc.

CE 1.1 When one has to determine the relative speed of two objects moving in opposite direction, he actually determines the relative speed mk by the formula which is used when they proceed in the same direction or vice versa .

It was committed by $20\frac{1}{3}\%$ of the candidates in this sample.

CE 2.1 One finds relative speed as

speed of one x speed of second.

It has weightage in the data = 2%

CE 3.1 One finds relative speed as

Speed of one speed of other.

It occupied a weightage of $\frac{2}{3}$% in the date.

UN II WORK AND TIME

Q.No. 6 Part A

When it is given that A can do a work in x days and B in y days and their one day's joint work is asked None of the expected errors can be a Kernel error.

KE 1. In such problems, one can only does a mistake of the form that for finding one day's joint work one first adds the number of days in which A does the work with the number of days in which B does the work andthen finds the joint one day's work as $\frac{1}{x+y}$ and it is none of the expected errors of this problem.

KE 2. One can proceed to find one day's joint work = one days work of A x one days work of B. It is also none of the expected errors of this problem.

KE 3. One may not understand the meaning of one day's joint work and consequently find's either oneday's work of A or one day's work of B.

CE 3.1 Finds one day's joint work = one day's work of A
The weightage of this error in the data = 1/3

CE 3.2 Finds one day's joint work = one days work of B
The weightage of error in the data = 1/3

UNIT WORK, TIME AND WAGES

Q. No. 7 In this problem, it is given that two persons Ram and Moti can do a piece of work in 20 days and 25 days respectively. If they do the work jointly and receive a sum of Rs. 90/-, what shall be the Ram's share.

ME 1. One can not correlate the data and consequently divides the amount equally to them or finds the shares in any other manner.

ME 2. One finds theproper shares but can not relate them to their owners, consequently finds Ram's share as the share of Moti.

CE 1.1 Shows Ram's share = Rs. 45/-
Weightage of this error in the data 1/3

CE 1.2 Shows Ram's share = Rs. 90/- - 20/- = Rs. 70/-
i.e. the amount Rs. 90/- is eliminished by the no. of days in which Ram completes the work.
Weightage of this error in the data = 2.1/3

CE 2.1 Finds share of Ram = Rs. 40/- which is actually the share of Moti.

Weightage of this error in the data = 46.2/3%

UNIT RATIO AND PROPORTION

Q. No. 8 Part A

When A : B :: 6 : 7 and B : C :: 14 : 17 are given and A : B : C is required =

ME 1 One may lack the knowledge of the fact that in both the relations $\frac{A}{x} = \frac{B}{y}$ and $\frac{B}{u} = \frac{C}{v}$, one has to make the denominator's of B equal, consequently he may ignore one of the data of B and writes A , B : C from rest of the data, or he may add the data of B in determining A : B : C.

CE 1.1 Writes A : B : C :: 6 : 7 : 17

Weightage of this error in the data = 16.1/3%

CE 1.2 Writes A : B : C :: 6 : 14 : 17

Weightage of this error in the data = $17\frac{2}{3}$ %

CE 1.3 Writes : B : C :: = 6 : (7+14) : 17 = 6 : 21 : 17

Weightage of this error in the data = $17\frac{2}{3}$ %

UNIT AVERAGE

Q. No.9 Part A

ME 1 One may not have any idea of the fact that average

of certain numbers always lies between the least and greatest of these.

CE 1.1 One may determine it as common difference of the given numbers if they are given in Arithmetic progression.
Weightage to this error in the data = 2/3%

CE 1.2 One may add all thenumbers and divide by 2.
Weightage to this error in the data = $3\frac{2}{3}$ %.

CE 1.3 One may only add them to find the average .
Weightaged to this error in the data = 4.1/3%

UNIT SQUARE AND ROOT AND CUBE AND IT

Q.No. 10 Part A
In this question square root of cube root of 64 is asked.

KE 1 One may confuse in this problem in understanding that whether it is a question on square root or a question on cube root.

KE 2. One may square root of cube root 64 as the number divided by its cube root.

CE 1.1 Finds cube root only and answer as 4.
Weightage to this error in the data = 28.1/3%

CE 1.2 Finds square root only and answer as 8
Weightage to this error in the data = 29%

CE 2.1 Finds the answer $\frac{64}{\text{cube root of } 64} = \frac{64}{4} = 16$

Weightage to this error in the data = $11\frac{1}{9}$ %.

UNIT LOGARITHMS

Q. No.11 Part A

In this question recall of the formula

$\log m^n = n \log m$

is asked.

KE 1 ? Error of ignorance of the meaning of m^n and the knowledge of the formula $\log m^n = n \log m$.

KE 2. ? Error due to hastiness.

CE 1.1 Writes $\log m^n = \log \frac{m}{n}$

Weightage to this error in the data = 20%

CE 1.2 Writes it = $\log mn$

Weightage to this error in the data = $11\frac{1}{9}$ %

CE 1.3 Writes it = $m \log n$

Weightage to this error in the data = $14\frac{1}{9}$ %

UNIT SETS

Q.No.12 Part A

In this question symbol of void (empty) set is to be recognised.

CE 1 Since 0 in the number system stands of nothing when associated with the things. One may think $\{0\}$ to stand for a set having no element i.e. void or empty set.

CE 2 Similarly in set theory $\{\}$ & Φ are symbols introduced for void set, one may not feel any difference between $\{\Phi\}$ and Φ or $\{\}$ and $\{\{\}\}$ whereas and $\{\Phi\}$ and $\{\{\}\}$ each is a single ton set.

CE 1.1 Chooses the symbol $\{a\}$ for void set.
The weightage to this error in the data = 5%

CE 2.1 Chooses the symbol $\{-\Phi\}$ for void set.
The weightage oto this error in the data = $34\frac{1}{3}$ %

CE 2.2 Chooses the symbol $\{\{\}\}$ for void set.
The weightage to this error in the data = $8\frac{1}{3}$%

UNIT SIMPLE LINEAR EQUATIONS

Q.No.13 Part A
In this question solution $\frac{5x}{6} = 10$ is asked.

CE 1 One does not verify the equation from the given answers and makes an error of ignoring 5x one of the figures in the equation which leads him to an incorrected answer.

CE 2 Computational error.

CE 1.1 Ignores 6 and finds $x = \frac{10}{5} = 2$

Weightage to this error in the data = $7\frac{2}{3}$ %

CE 1.2 Ignores 5 and finds $x = 10 \times 5 = 60$

Weightage to this error in the data = 5%

CE 2.1 Finds $x = 10 \times 5$ by doing computational error.

Weightage to this error in the data = $4\frac{1}{3}$ %

UNIT TRIGONOMETRICAL RATIOS

Q.No.14 Part A

It is a question on recall of the formula of inverse of $\sin\theta = \operatorname{cosec}\theta$

KE 1 Error of the ignorance of the meaning of the word inverse of $\sin\theta$

CE 1.1 Since $\sin^2\theta + \cos^2\theta = 1$ takes $\cos\theta$ as inverse of $\sin\theta$

Weightage to this error in the data = $24\frac{1}{3}$ %

CE 1.2 Since sin and sec θ both have their first letter as s and he has read relations between $\sin\theta$ & $\operatorname{cosec}\theta$ and $\cos\theta$ and $\sec\theta$, confuses and takes $\sec\theta \sin\theta = 1$ as $\sin\theta = 1$ and thus answers inverse of $\sin\theta = \sec\theta$ ~~$\frac{1}{2} = \sec$~~

Weightage to this error in the data = 10%

CE 1.3 Writes inverse of $\sin\theta = \tan\theta$

Weightage to this error in the data = $5\frac{1}{3}$ %

UNIT I PROBLEMS IN EQUATIONS

Q.No.15 Part A

The question reads as " Square of a number ** x exceeds it by 42 ". The equation involving x is -

KE 1. Ignorance of the meaning of the word exceed mathematically.

KE 1.1 Finds the equation as $x^2 + x = 42$ as if he understands that exceeds means addition
Weightage to this error in data = 9$\frac{1}{2}$%

CE 1.2 One finds the equation as $x - x^2 = 42$ as if one understands exceeds meaning subtracted
Weightage to this error in data = 25$\frac{2}{3}$ %

CE 1.3 One understands meaning of exceeds by division and hence obtains the required equation in the form $x^2 \div x = 42$

Weightage to this error in the data = 2$\frac{1}{2}$ %

UNIT THE CALCULATION OF THE VALUES OF t-ratios FROM THE GIVEN VALUE OF ANOTHER t-ratio

Q.No.15 Pt. A

Given Cos $\theta = 4/5$, Find tan θ

KE -1 Error of ignorance of thedefinition of tan θ

KE-2 Error of the ignorance of the relation between tan θ and cos θ

CE 1.1 One takes tan θ as sin θ and finds its value = 3/5

CE 1.2 One takes tan θ as cot θ and finds its value = 4/3

CE 2.1 One takes tan θ as cos θ it self or think

= CE 1.3 tan θ = cos θ and chooses its value = 4/5

UNIT RELATION BETWEEN AREA OF A TRIANGLE AND A RECTANGLE SITUATED ON THE SAME BASE AND BETWEEN THE SAME PARALLELS

Q.No.17 Part A

In this question the relation between area of rectangle and area of triangle is asked when they are situated between the same parallels andon the same base.

KE 1 Error of ignorance this relation.

CE 1.1 Takes Area of rectangle = Area of triangle

Weightage to this error in data = $16\frac{2}{3}$ %

CE 1.2 Takes Area of rectangle = Thrice the area of triangle

Weightage to this x error = 16%

CE 1.3 Takes area of rectangle = 4xarea of the triangle

Weightage to this error = ~~10 2/3%~~ $10\frac{1}{3}$ %.

UNIT AREA OF WALLS OF A ROOM

Q.No.18 Part A

In this question area of smaller wall of the room 12m x 10 m x 6 m, is asked.

ME 1 Error of not recognising the data.

ME -2 Error due to lack of concentration while reading the problem.

CE 1.1 Considers 10m and 6 m as length and breadth and 12m as height and consequently writes answer as 12 x 6 = 72 sq. m.

Weightaged to this error in data = 17.2/3%

CE 1.2 Confuses smaller wall with the floor and chooses the required area = 12 x 10 = 120 sq.m.

Weightage to this error in data = 11%

CE 2.1 She does not read the problem properly and considers it as a question on four walls and chooses answer as 2 (12 + 10) x 6 sq.m.

Weightage to this error in data = 50$\frac{2}{3}$ %

APPENDIX - D

A LIST OF KERNEL ERRORS AND CONSEQUENTIAL ERRORS AS DISCERNED FROM SECTION 'E'

N.B. W (C E 1.2) stands for " the weightage of the error CE 1.2 in the data ".

UNIT FACTORS

QUESTION NO. 1(a) FACTORIZE $25x^4 + 20x^2y^2 + 4y^4$

KE 1 Error of language due to lack of information and practice of it.

KE 2 Error of the ignorance of simple monomial factors i.e. of the ignorance of the knowledge of obtaining square roots of product of two terms.

KE 3 Error due to wrong concept of the formula
$(a + b)^2 = a^2 + b^2 + 2ab$

CE 1.1 One does not use the sign of equality between two different steps in the solution.

W (CE 1.1) = 32.7%

CE 1.2 One misses to write + between two terms of an expression

W (CE 1.2) = 13.6%

[illegible] [illegible]

CE 2.1 writes $4y^2 = 2(y^2)^2 = (2y)^2$ etc.

U (CE 2.1) = 19%.

CE 2.2 One is unable to write the factors.

U (CE 2.2) = 26%

CE 3.1 One writes $25x^4 + 20x^2y^2 + 4y^4 = (5x^2)^2 + (2y^2)^2$

U (CE 3.1) = 4%

CE 3.2 One writes the answer as $(5x + 2y)^2$ or simply $5x^2 + 2y^2$ etc.

U (CE 3.2) = 6.5%

Q.No.1(b) FACTORIZE = $x^2 - 49y^2$

KE 1 and KE-2 are the same as given for Q.No.1(a)

CE 1.1 Same as given for Q. No. 1 (a)

CE 1.2 Same as given for Q . No. 1(a)

U (CE 1.2) = 1.3%

CE 1.3 One writes " taking square root, we have "-

U (CE 1.3) = .4%

CE 2.1 Same as given for question No. 1 (a)

U (CE 2.1) = 21%

CE 2.2 Sameas given for question no. 1(b)

U (CE 2.2) = 18%

QUESTION NO. 1(c) FACTORIZE x^3+x+x^2+1

KE 1 Same as given for Q. No. 1 (a)

KE 2 Error of ignorance of the knowledge of factorization by grouping.

CE 1.1 Same given for Q.No. 1 (a)

U (CE 1.1) = 65.5%

CE 1.2 Same as given for Q.No. 1 (a)

U (CE 1.2) = 23.7%

CE 2.1 One can not group the terms

U (CE 2.1) = 11.3%

CE 2.2 After grouping one can factorize each group of terms

U (CE 2.2) = 17%

CE 2.3 One cannot unite factors.

U (CE 2.3) = 16%

QUESTION NO. 1 (c) FACTORIZE $2 + 5x + 3x^2$

ME 1 Same as given for Q.No. 1 (a)

ME 2 Error of ignorance of the knowledge of factorization of trinomials.

CE 1.1 Same as given for Q.No. 1 (a)

U (CE 1.1) = 65.6%

CE 1.2 Same as given for Q.No. 1 (a)

U (CE 1.2) = 20.6%

CE 2.1 One cannot split up 5x into 2x + 3x

U (CE 2.1) = 20%

CE 2.2 One after spliting up $5x$ in o $2x + 3x$, cannot group the terms correctly

U (CE 2.2) = 23.4%

CE 2.3 One cannot factorize each group of terms

U (CE 2.3) 30.6%

CE 2.4 One cannot write the factors

U (CE 2.4) = 20%

UNIT CUBE ROOT QUESTION NO. 2

Find the cube root of $2\frac{10}{27}$

ME 1. Error of ignorance of the knowledge of symbol and method of finding cube root.

ME 2 Error of language.

CE 1.1 One does not use symbol of cube root

U (CE 1.1) = 83.6%

CE 1.2 One does not discriminate cube root from square root

U (CE 1.2) = 8.4%

CE 1.3 One finds $3\sqrt[3]{\frac{8}{8}} = 3\sqrt[3]{\frac{1}{1}}$

CE 2.1 One writes the solution as

$\frac{\overline{64}}{27} = \frac{\overline{4}}{3} = 1\frac{\overline{1}}{3}$ etc.

U (CE 2.1) = 28.8%

UNIT SIMPLE INTEREST QUESTION NO. 3

At what rate percent of interest, the sum of Rs. 600/- will amount to Rs. 720/- in 3 years 6 months.

ME 1 Error of the ignorance of the concept of interest or rate of interest.

ME 2 Error of the ignorance of the symbols of the formula or the formula itself.

ME 3 Error of the ignorance of the fact that in calculating interest, the time is to be taken in one unit only i.e. either in years or in months.

ME 4 Error in simplification.

CE 1.1 One does not know that interest is always calculated on Principal

U (CE 1.1) = 2.8%

CE 1.2 One takes the interest on Rs. 100/- for 3/2years as the rate percent of interest

U (CE 1.2) = 1.9%

CE 2.1 One knows formula but cannot substitute the data

U (CE 2.1) = 0.9%

CE 2.2 One could not use the formula , tried for unitary law but could not succeed to arrive at the correct result :

U (CE 2.2) = 10.2%

CE 3.1 Makes error in converting 3 years 6 months into years

U (CE 3.1) = .9%

CE 4.1 Error in simplification

U (CE 4.1) = 15%

QUESTION NO. 3 (ALTERNATIVE PART)

Find the simple interest on Rs. 700/- for 2 years 1 months at the rate of 75 p. per hundred per month.

KE 1 Error of the ignorance of the formula or the symbols used in the formula.

KE 2 Error in simplification and in converting Re 75p/ 100 per month into Rs. 3/4 /100 per year or in converting 2 years 1 months into 25 months.

CE 1.1 One is unable to substitute the data in the formula

U (CE 1.1) = 4.2%

CE 1.2 One is unable to recall the formula

U (CE 1.2)=17.8%

CE 2.1 Error in simplification

: (CE 2.1) = 22.7%

CE 2.2 Error in converting 75p/100 per month into per hundred per year

U (CE 2.2) = 26.8%

UNIT COMPOUND INTEREST QUESTION NO. 4

The population of a city is 106400. If the population increase by 10% every year. What will be the population after two years.

KE 1 Error of the ignorance of the concept of compound interest.

KE 2 Error of confusing between increased population and increase in population.

KE 3 Error in using the data in finding increase in population after one or two years and error in simplification.

CE 1.1 Finds increase in population in two years as a problem on simple interest

U (CU 1.1) = 29.8%

CE 2.1 FINDS INCREASE in population in two years and m writes it as the answer for thepopulation m after two years

U (CE 2.1) = 5%

CE 3.1 Calculates increase in population in correctly as

$$K \frac{100000 \times 160}{110} \text{ etc}$$

U (CE 3.1) = 2.1%

CE 3.2 Simplification error.

U (CE 3.2) = 19.2%

UNIT AVERAGE QUESTION NO.5

Average of five numbers=15,
Average of last three = 17,
find the average of first two.

KE 1 Error of ignorance of the concept of average or wrong concept of average.

KE 2 Error of confusing sum of numbers with average of numbers.

KE 3 Computational error.

CE 1.1 Takes average of first two = Average of five - average of lastthree

U (CE 1.1) = 1.9%

CE 1.2 Takes average = $\frac{15 + 17}{2}$ = 16

U (CE 1.2) = 3%

CE 1.3 Takes average = $\frac{17 - 15}{2}$ = 1

U (CE 1.3) = 1.1%

CE 2.1 Writes average of first two = 75-51=24 etc.

U(CE 2.1) = 27.3%

CE 2.2 Average of numbers = sum of numbers 1 15x5 etc.

U (CE 2.2) = 16.0%

CE 3.1 Computational error

U (CE 3.1) = 5%

CE 3.2 Finds sum of first two 1 sum of five + sum of last three

U (CE 3.2) = 4.1%

UNIT TIME AND DISTANCE S.NO. 6

(Relative speed)

Mohan and Sohan started from Ajmer and Vijainagar respectively at 10 A.M. to see each other. Mohan and Sohan travel at speeds of 5 kms. and 7 km per hour respectively. Find at what time will they meet each other and how much distance each would have travelled by them, if the distance between the places is 60 kms.

KE 1	Error of ignorance of the unit of speed
KE 2	Error of confusing the relative speed with the one when they travel in the same direction.
KE 3	Error in recalling the formula D = V x t.
KE 4	Error in understanding that they meet after travelling for the same time or error in finding the time of meeting.
CE 1.1	Writes wrong units of speed U (CE 1.1) = 16.9%
CE 1.2	Does not write unit of speed. U (CE 1.2) = 6.3%
CE 2.1	Finds relative speed = 7-5 = 2 km/hr. U (CE 2.1) = 6.3%
CE 3.1	Takes D x t = V or D x V = t etc. U(CE 3.1) = 2.1%
CE 4.1	Finds time of meeting other than 3pm or 15 hrs. U(CE 4.1) = 6.3%
CE 4.2	Finds different times for both U (CE 4.2) = 10.6%

UNIT SIMULTANEOUS EQUATIONS QUESTION NO. 7

(Problems)

Ten years ago, the age of the father was five times the age of his son and twenty years hence the age of the father will be twice the age of his son. Find the age of the father.

KE 1 Error of not understanding the question, thus can not from the required equations or wrongly form the equations.

KE 2 Computational mistake due to lack of concentration.

Please see the remaining portion of this section on page 133.

UNIT SETS Q.NO. 7(ii)

Represent $A \cap B$ by Venn diagram

KE 1 One may have an error of not drawing the diagrams of all possible cases

U (KE 1) = 75%

UNIT CIRCLE (AREA AND CIRCUMFERENCE)

Question No. 8

The circumference of the top of a circular table is 198 cm. Find its diameter.

KE 1 Error of confusing area with circumference.

KE 2 Error due to lack of concentration.

KE 3 Error in recalling the formula for circumference.

CE 1.1 Used πr^2 = 198

U (CE 1.1) = 3.6%

CE 2.1 Finds r and answer its value as answer

U (CE 2.1) = 1.2%

CE 2.2 Omit unit

U (CE 2.2) = 2%

CE 2.3 Computational error

U (CE 2.3) = 3.2%

CE 3.1 Uses $d = \frac{c}{2\pi}$ or $d = \frac{2\pi}{c}$ or $c = \pi c$

U (CE 3.1) = 16.3%

UNIT CYLINDER J.NO. 9

The height of a cylinder is 45 cm and its radius is 14 cm. Find the curved and total surface of the cylinder.

ME 1 Error in recalling formula for circular plane faces and curved surface etc.

ME 2 Error in recalling for aula for total surface.

ME 3 Error of omitting units or of writing wrong units or of computation.

~~CE 1.1 Formation of incorrect equations~~

~~U (CE 1.1) = 2.6%~~

Please See remaining portion of this Section on page 134 marked 'X'

C.E. 1.1. Formation of incorrect equations
W (CE 1.1) = 2.8 %

CE 1.2 Cannot form an equation

W (CE 1.2) = 21.7%

CE 2.1 Mistakes in simplification

W (CE 2.1) = 9%

CE 2.2 Mistakes in answering i.e. about son's age as father's age

W(CE 2.2) = 0%

UNIT SET; [illegible] 7(2)(ALTERNATIVE)

If A = $\{1,2,3,4\}$, B = $\{2,4,6,8\}$ and C=$\{3,4,5,6\}$ then prove that A ∪ (B ∪ C) = (A ∪ B) ∪ C

KE 1 Error of ignorance of the concept of Union

KE 2 Error of the ignorance of the symbols used to represent sets etc.

KE 3 Computational error.

KE 4 Error of ignoring calculations and of using only venn diagrams to prove the result.

CC 1.1 Finds A∪B, B∪C incorrectly showing ignorance of the concept of union

W (CE 1.1) = 32.1%

CC 2.1 Error in symbol of representing set

W (CE .1) = 17.9%

CE 2.2 Error of not putting comma between consequentive elements in the set.

U (CE 2.2) = 1.5%

CE 3.1 Writes A U(B U C) = ( ) (A U B) U C

E = {1,2,3,4,5,6,7,8}

U (CE 3.1) = 8%

CE 4.1 Uses venn diagrams to prove theresult

U (CE 4.1) = 2.2%

Please see remaining information of this section on page 13

* CE 1.1 Takes curved surface $\pi r^2 h$.

U (CE 1.1) = 19.8%

CE 1.2 Takes plane surface area = $2\pi r$

U (CE 1.2) = 16.1%

CE 2.1 Takes total surface = $2\pi rh + \pi r^2$

U (CE 2.1) = 4.4%

CE 2.2 Takes total surface = curved surface

U (CE 2.2) = 5.5%

CE 2.3 Does not compute total surface as he can not recall its formula

U (CE 2.3) = 1.8%

CE 3.1 Computation error

U (CE 3.1) = 20%

CE 3.2 Wrong units

U (CE 3.2) = 9.3%

CE 3.3 Omission of units

U (CE 3.3) = 22.5%

UNIT AREA OF RECTANGULAR PATHS

S.No. 9 (Alternative)

A rectangular garden is 180 m long and 120 m wide. There are two paths each 5 m wide in the middle of the garden and parallel to its length and breadth. Find the total area of the paths.

KE 1 Error of misunderstanding the position of paths.

KE 2 Error in understanding about common path.

KE 3 Error of units and of computation.

CE 1.1 One draws the path inside and along the boundary i.e. not in the middle of the garden

U (CE 1.1) = 7.4%

CE 1.2 One draws the two paths either outside & along the boundary of the garden or at any other incorrect position

U (CE 1.2) = 3.7%

CE 2.1 One does not take account the area of common path which is repeated in finding the total area of the paths

U (CE 2.1) = 3.1%

CE 3.1 One does error in computation

U (CE 3.1) = 6.7%

CE 3.2 One omits units or writes wrong units

U (CE 3.2) = 10.4%

UNIT TRIGONOMETRICAL RATIOS AND USE OF STANDARD IDENTITIES.

Q.No. 10 Prove that $\cot^2\theta (\sec^2\theta - 1) = 1$

KE 1 Error of Agnosance or the knowledge of standard identities.

KE 2 Error in opening brackets,or computation error.

ME 1.1 One does not use the formula $\sec^2\theta = 1+\tan^2\theta$ or $1-\cos^2\theta = \sin^2\theta$ correctly

U (CE 1.1) = 57.1%

CE 1.2 One does not recall the formula $\cot\theta = \frac{1}{\tan\theta}$

or $\cot\theta = \frac{\cos\theta}{\sin\theta}$

U (CE 1.2) = 24.7%

CE 2.1 Computation error

U (CE 2.1) = 19.1%

CE 2.2 Mistake of opening brackets.

U (CE 2.2) = 18%

UN IT SOLUTION OF RIGHT ANGLED TRIANGLE

Q.No. 10 (Alternative)

In the $\triangle ABC$, $C = 90^0$, $a = 5$, $b = 5\sqrt{3}$, the find the remaining elements of the triangle.

KE 1 Error of ignorance of the knowledge of the sides a,b,,c and the pythagores theorem.

KE 2 Error in recognising the remaining elements.

KE 3 Error of ignorance of the knowledge of trigonometrical ratios of standard angles.

U (KE 3) = 16.7%

KE 4 Computation error.

U (KE 4) = 83.1%

CE 1.1 One does not know Pythagoras theorem

U (CE 1.1) = 42.9%

CE 1.2 One does not recognise the sides a,b,c

U (CE 1.2) = 28.6%

CE 2.1 One determines one angle only or one side only

U (CE 2.1) = 13.1%

CE 2.2 One is unable to recognise remaining elements

U (CE 2.2) = 23.8%

UNIT PERIMETER AND AREA OF RECTANGULAR FIELDS:

Q.No.11 The perimeter of a square field is 200 m.Find the length of a rectangular field whose breadth is 25m, and area equal to that the square.

KE 1 Error of ignorance of the concept of the perimeter, Area of rectangle, rectangle and a square.

CE 1.1 Takes perimeter of the square = its area

U (CE 1.1) = 25.2%

CE 1.2 Takes perimeter square = its one side

U (CE 1.2) = 14.4%

CE 1.3 One uses length = Area x breadth

U (CE 1.3) = .4%

CE 1.4 One takes rectangle and square the same

U (CE 1.4) = 1.6%

UNIT PYTHAGORAS THEOREM

e.g.No.12 In a right angled triangle, the hypotenuse is 10 cm and one side is 6 cm. Find the length of the remaining side.

KE 1 Error of the ignorance of the knowledge of Pythagoras theorem.

KE 2 Computational error or language error.

CE 1.1 Finds Area = 10 x 6 unnecessarily and incorrectly inplace of the remaining side

U (CE 1.1) = 2.0%

CE 1.2 Applies any other wrong formul to find the remaining side

U (CE 1.2) = 24.1%

CE 2.1 Computation error

U (CE 2.1) = 2.8%

CE 2.2 Does not put sign of equality between two different steps.

U (CE 2.2) = 1.2%

CE 2.3 Writes $AD^2 = \sqrt{64} = 8$ cm etc.

U (CE 2.3) = 7.1%

UNIT VOLUME OF A CUBOID

Q.No. 19 A cistern is 4 m long, 2m 5 cm wide and 1 m 50 cm deep. If one litre of water occupies 1000 cm^3 of space. Find how many litres of water can be contained in the cistern.

KE 1 Error of ignorance of the concept of volumn of a cuboid. Consequently there remains confusion in the formula for the volume of cuboid.

KE 2 Error of ignorance of the knowledge of units.

KE 3 Computation error

U (KE 3) = 10%

CE 1.1 Instead of volume, takes area of cistern = abc i.e. l x b x h

U (CE 1.1) = 12.7%

CE 1.2 Takes volume of cubroid = 2(lb + bh + hl)

U (CE 1.2) = 14.3%

CE 1.3 Takes volume of cuboid = 2(l+b)h

U (CE 1.3) = 13.1%

CE 2.1 One can not convert m^3 into cm^3 or cm^3 into m^3.

U (CE 2.1) = 38.2%

CE 2.2 She cannot correlate the volume of one litre of water with volume of cuboid.

U (CE 2.2) = 26.3%

CE 2.3 One has no idea about litre etc.

U (CE 2.3) = 21.8%

UNIT GRAPH

Q.No. 14

KE 1 Error of ignorance of the knowledge of selecting proper scale

U (KE 1) = 36.4%

KE -2 Error of ignorance of the knowledge of plotting of points with respect to the choosen scale and drawing graph etc.

KE 3 Error = of the ignorance of reading the graphs and interpreting the result.

KE 2.1 One can not plot points accurately

u (KE 2.1) = 49.5%

KE 2.2 One has no idea about the scale and plotting

u (KE 2.2) = 46.6%

KE 2.3 One joints the plotted points inaccurately !

u (KE 2.3) = 2.9%

APPENDIX - C

In conclusion we give below a list of significant errors which have come accross in this study. It is worthwhile to mention here that we have taken an error to be significant if it has weightage in studies more than or equal to 10% $\frac{5}{5}$

SIGNIFICANT ERRORS OF QUESTION [illegible]

[illegible] OF [illegible]

[illegible].No.1	Error E
[illegible].No.2	Error C and D
[illegible].No.3	Error A
Q.No.4	Error B
Q.No.5	Error B
Q.No.6	Nil
Q.No.7	Errors B and C
Q.No.8	Errors A, B and D
Q.No.9	Nil
Q.No.10	Errors B and C
Q.No.11	Errors A, B and C
Q.No.12	Error B
Q.No.13	Nil
Q.No.14	Errors A and B
Q.No.15	Error C
Q.No.16	Errors B, C and D
Q.No.17	Errors A, C and D
Q.No.18	Errors B, C and D

APPENDIX - C

SIGNIFICANT ERRORS OF SECTION B OF ESSAY AND SHORT ANSWER TYPE QUESTIONS.

	Error Nos.
(a) No. 1(a)	1, 2, 3, 4
(b) No. 1(b)	1, 3, 4,
(c) No. 1(c)	1, 2, 3, 4, 5,
(d) No. 1(d)	1, 2, 3, 4, 5, 6,
(i) No. 2	1, 4
(ii) No. 3	1, 3, 4
(iii) No. 3(alt)	2, 3, 4, 5
(iv) No. 4	1, 4
(v) No. 5	1 and 7
(vi) No. 6	1 and 6
(vii) No. 7	4
(viii) No. 7(i) (alt.)	1 and 3
(ix) No. 7(ii) (alt.)	1
(x) No. 8	4
(xi) No. 9	1, 2, 6 and 7.
(xii) No. 9(alt.)	5
(xiii) No. 10	1, 2, 3, 4
(xiv) No. 10(alt)	all the six
(xv) No. 11	1 and 4.

Q.No. 12 ∎ 4

Q.No. 13 all seven

Q.No. 14 1,2,3 and 4.

I suggest that those errors should be sent to all the teachers teaching the subject, so that they may use it to improve their teaching. Those errors can also be used by the book writers and paper setters m in improving their work.

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